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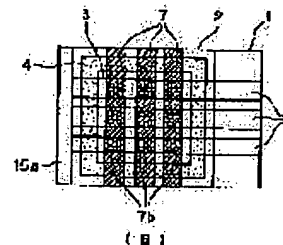
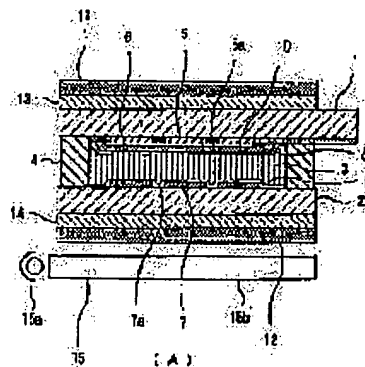
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(54) LIQUID CRYSTAL DISPLAY DEVICE AND ELECTRONIC EQUIPMENT

(57)Abstract:

PROBLEM TO BE SOLVED: To make an image display with high contrast and high quality both in a reflective display mode and in a transmissive display mode in a liquid crystal display device exchangeable between a reflective display and a transmissive display by suppressing a double image due to parallax and a blot on the display.

SOLUTION: When a backlight 15 is turned on in the dark, as light from a light source passes through a semitransparent reflection plate 7 via a polarizing plate 12 and a phase difference plate 14, and it is guided into a liquid crystal layer 3 to perform a transmissive display. In the sun since an incident external light passing through a polarizing plate 11, a phase difference plate 13 and the liquid crystal layer 3 is reflected on the semitransparent reflection plate 7, a reflective display is performed. A driving voltage is switched correspondingly to either a reflective display mode or a transitive display mode in order to apply a driving voltage most suited to reflectance and transmittance characteristics of the driving voltage to liquid crystal.



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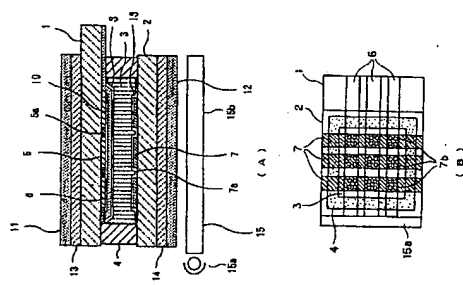
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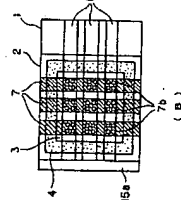
(54) 【発明の名称】 液晶装置及び電子機器

【要約】 反射型表示と透過型表示とを切換え可能な液晶装置において、投写による二重映りや表示のじみ等の発生を抑え、反射型表示時にも透過型表示時にも高コントラストで高品位の画像表示を可能とする。

【解決手段】 暗所でバックライト15を点灯すると、光導光板12、位相差板14を介して半透過反射板7を透過するので、液晶層3内に導入され、透過型表示が行われる。明所で偏光板11、位相差板13、液晶層3を介して入射した外光は、半透過反射板7で反射されるので、反射型表示が行われる。駆動電圧に対する反射率特性及び透過率特性に基き、駆動電圧が液晶に印加されるように、反射型表示時と透過型表示時とで駆動電圧が切り換えられる。



(A)



(B)

(1) 【特許請求の範囲】

【請求項1】 透明な一対の第1及び第2基板と、該第1及び第2基板間に挟持された液晶層と、前記第1基板の前記液晶層側の面に形成された透明な第1電極と、

前記第2基板の前記液晶層側の面に形成された半透過反射層からなる第2電極と、前記第2基板の前記液晶層と反対側に配置された照明装置と、

該照明装置の点灯時と非点灯時とで前記第1及び第2電極を介して前記液晶層に印加される液晶駆動電圧が同一画像に対して相異なるように前記第1及び第2電極を駆動する駆動手段とを備えたことを特徴とする液晶装置。

【請求項2】 透明な一対の第1及び第2基板と、該第1及び第2基板間に挟持された液晶層と、

前記第1基板の前記液晶層側の面に形成された透明な第1電極と、

前記第2基板の前記液晶層側の面に形成された半透過反射層と、

該半透過反射層と前記液晶層との間に形成された透明な第2電極と、前記第2基板の前記液晶層と反対側に配置された照明装置と、

該照明装置の点灯時と非点灯時とで前記第1及び第2電極を介して前記液晶層に印加される液晶駆動電圧が同一画像に対して相異なるように前記第1及び第2電極を駆動する駆動手段とを備えたことを特徴とする液晶装置。

【請求項3】 前記半透過反射層は、各画素内に前記照明装置からの光が透過可能な開口部が設けられた反射膜からなることを特徴とする請求項1又は2に記載の液晶装置。

【請求項4】 前記駆動手段は、前記第1電極に電圧を供給する第1供給手段と、

該第1供給手段が供給する電圧を前記非点灯時に応じて反射型表示用の設定に切り換え且つ前記点灯時に応じて透過型表示用の設定に切り換えるように前記第1供給手段を制御する第1制御手段とを備えたことを特徴とする請求項1から3のいずれか一項に記載の液晶装置。

【請求項5】 前記照明装置における前記点灯と前記非点灯とを切り換える点灯切換手段を更に備えており、該点灯切換手段による切り換え動作に同期して前記第1制御手段は、前記第1供給手段が供給する電圧を反射型表示用の設定又は透過型表示用の設定に切り換えることを特徴とする請求項4に記載の液晶装置。

【請求項6】 前記駆動手段は、前記第2電極に電圧を供給する第2供給手段と、

該第2供給手段が供給する電圧を前記非点灯時に応じて反射型表示用の設定に切り換え且つ前記点灯時に応じて透過型表示用の設定に切り換えるように前記第2供給手段を制御する第2制御手段とを備えたことを特徴とする請求項1から5のいずれか一項に記載の液晶装置。

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項1から5のいずれか一項に記載の液晶装置。

【請求項7】 前記第2供給手段は、階調データの示す階調レベルに応じた大きさの実効値を有する電圧を前記第2電極に供給し、

前記第2制御手段は、各階調レベルに対する前記実効値の大きさを、前記非点灯時に応じて反射型表示用の設定に切り換え且つ前記点灯時に応じて透過型表示用の設定に切り換えるように前記第2供給手段を制御することを特徴とする請求項6に記載の液晶装置。

【請求項8】 前記半透過反射層と前記第1基板との間に、カラーフィルタを更に備えたことを特徴とする請求項1から7のいずれか一項に記載の液晶装置。

【請求項9】 前記半透過反射層が凹凸を有することを特徴とする請求項1から8のいずれか一項に記載の液晶装置。

【請求項10】 請求項1から9のいずれか一項に記載の液晶装置を備えたことを特徴とする電子機器。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、液晶装置の技術分野に属し、特に、反射型表示と透過型表示とを切り換えて表示することのできる液晶装置及びこの液晶装置を用いた電子機器の技術分野に属する。

【0002】

【従来の技術】 従来、反射型液晶装置は消費電力が小さいために携帯機器や装置の付属部品などに多用されているが、外光を利用して表示を視認可能にしているため、暗い場所では表示を視認することができないという問題点があった。このため、明るい場所では通常の反射型液晶装置と同様に外光を利用するが、暗い場所では内部の光源により表示を視認可能にした形式の液晶装置が提案されている。これは、特開昭57-049271号公報、特開昭57-049271号公報などに記載されているように、液晶パネルの観察側と反対側の外面に偏光板、半透過反射板、バックライトを順次配置した構成をしている。この液晶装置では、周囲が明るい場合には外光を取り入れて半透過反射板にて反射された光を利用して反射型表示を行い、周囲が暗くなるとバックライトを点灯して半透過反射板を透過させた光により表示を視認可能とした透過型表示を行う。

【0003】 別の液晶装置としては、反射型表示の明るさを向上させた特開平8-292413号公報に記載されたものがある。この液晶装置は、液晶パネルの観察側と反対側の外面に半透過反射板、偏光板、バックライトを順次配置した構成をしている。周囲が明るい場合には外光を取り入れて半透過反射板にて反射された光を利用して反射型表示を行い、周囲が暗くなるとバックライトを点灯して偏光板と半透過反射板を透過させた光により表示を視認可能とした透過型表示を行う。このような構成

成にすると、液晶セルと半透過反射板の間に偏光板がないため、前述した液晶装置よりも明るい反射型表示が得られる。

【00041】
【発明が解決しようとする課題】 しかしながら、上記特開8-292413号公報に記載された液晶装置では、液晶層と半透過反射板との間に透明基板が介在するため、二重映りや表示のにじみなどが発生してしまうという問題点がある。

【00051】更に、近年の携帯機器やOA機器の発展に伴って液晶表示のカラー化が要求されるようになっており、反射型液晶装置を用いるような機器においてもカラー化が必要となる場合が多い。ところが、上記公報に記載されている液晶装置とカラーパネルを組み合わせた方法では、半透過反射板を液晶パネルの後ろに配置しているため、液晶層やカラーパネルと半透過反射板との間に液晶パネルの厚い透明基板が介在し、視座によって二重映りや表示のにじみなどが発生してしまい、十分な景色を得ることができないという問題点がある。

【00061】この問題を解決するために、特開9-258219号公報では、液晶層と接するように反射板を配置する反射型カラー液晶装置が提案されている。しかしながら、この液晶装置では、周囲が暗くなると表示を隠蔽することができない。

【00071】他方、特開7-318929号公報では、液晶セルの外面に半透過反射膜を被る偏光電極を設けた半透過反射型の液晶装置が提案されている。しかしながら、この液晶装置では、同一の駆動電圧（例えば、所開又はドライバ回路やドライバ回路）を用いて反射型表示時も透過型表示時も液晶駆動が行われ、同一の画像データに対する駆動電圧は、反射型表示時でも透過型表示時でも一定である。しかしながら、本発明者らの研究によれば、一般にこの種の半透過反射型の液晶装置においては反射型表示時における液晶駆動電圧に対する反射膜の特性と透過型表示時における液晶駆動電圧に対する透過膜の特性とは一致していない。この結果、特開7-318929号公報等の液晶装置では、駆動電圧において反射型表示時に良好なコントラストや表示速度が得られるように画像データの階層に対する液晶駆動電圧の設定を行うと、透過型表示時には良好なコントラストや表示速度は得られない。逆に、駆動電圧において透過型表示時に良好なコントラストや表示速度が得られるように画像データの階層に対する液晶駆動電圧の設定を行うと、今度は反射型表示時には良好なコントラストや表示速度は得られないという問題点がある。

【00081】本発明は上述の問題点に鑑みながら、透明な液晶装置において、視座による二重映りや表示のにじみなどが発生せず、反射型表示時も透過型表示時も高コントラストで高品質の画像表示が可能な半透過反射型の液

晶装置及びその液晶装置を用いた電子機器を提供することを課題とする。

【00091】

【課題を解決するための手段】 本発明の第1の液晶装置は上記課題を解決するために、透明な第1及び第2基板と、該第1及び第2基板間に挟持された液晶層と、前記第1基板の前記液晶層側の面に形成された透明な第1電極と、前記第2基板の前記液晶層側の面に形成された半透過反射層からなる第2電極と、前記第2基板の前記液晶層と反射側に配置された照明装置と、該照明装置の点灯時と非点灯時とで前記第1及び第2電極を介して前記液晶層に印加される液晶駆動電圧が同一画像に対して相異なるように前記第1及び第2電極を駆動する駆動手段とを備えたことを特徴とする。

【00101】本発明の第1液晶装置によれば、反射型表示時には、半透過反射層（第2電極）は、第1基板側から入射した外光を液晶層側に反射する。この際、半透過反射層（第2電極）は、第2基板の液晶層側に配置されているため、液晶層と半透過反射層（第2電極）との間に隙隙が生じ、そのため視差に起因する表示の二重映りや表示のにじみが発生しない。他方、透過型表示時には、照明装置から発せられる第2基板側に入射した外光を液晶層側に反射する。この際、半透過反射層（第2電極）を介して液晶層側に透過する。従って、暗所では光源光を用いて明るい表示が可能となる。

【00111】特に駆動手段により、照明装置の点灯時と非点灯時とでは、第1及び第2電極を介して液晶層に印加される液晶駆動電圧が同一画像に対して相異なるように第1及び第2電極が駆動される。即ち、一般に半透過反射型の液晶装置では反射型表示時における液晶駆動電圧に対する反射率の特性と透過型表示時における液晶駆動電圧に対する透過率の特性とは一致していないため、本発明のように液晶駆動電圧を相異ならしめることにより、照明装置を非点灯した反射型表示時に当該反射型表示における液晶駆動電圧に対する反射率の特性に適合した透過型表示時に当該透過型表示における液晶駆動電圧に対する透過率の特性に適合した液晶駆動電圧を印加することにより、透明な第1及び第2基板と、前記第1基板の前記液晶層側の面に形成された透明な第1電極と、前記第2基板の前記液晶層側の面に形成された半透過反射層と、該半透過反射層と前記液晶層との間に形成された透明な第2電極と、前記第2基板の前記液晶層と反射側に配置された照明装置と、該照明装置の点灯時と非点灯時とで前記第1及び第2電極を介して前記液晶層に印加さ

れる液晶駆動電圧が同一画像に対して相異なるように前記第1及び第2電極を駆動する駆動手段とを備えたことを特徴とする。

【00131】本発明の第2液晶装置によれば、反射型表示時には、半透過反射層は、第1基板側から入射した外光を液晶層側に反射する。この際、半透過反射層は、第2基板の液晶層側に配置されているため、液晶層と半透過反射層との間に隙隙が生じ、そのため視差に起因する表示の二重映りや表示のにじみが発生しない。他方、透過型表示時には、照明装置から発せられる第2基板側から入射した光源光を、半透過反射層を介して液晶層側に透過する。従って、暗所では光源光を用いて明るい表示が可能となる。

【00141】特に駆動手段により、照明装置の点灯時と非点灯時とでは、第1及び第2電極を介して液晶層に印加される液晶駆動電圧が同一画像に対して相異なるように第1及び第2電極が駆動される。これにより上述した本発明の第1の液晶装置の場合と同様に、照明装置を非点灯した反射型表示の際に当該反射型表示における液晶駆動電圧に対する反射率の特性に適合した透過型表示の際に当該透過型表示における液晶駆動電圧に対する透過率の特性に適合した液晶駆動電圧を印加することにより、透明な第1及び第2基板と、前記第1基板の前記液晶層側の面に形成された透明な第1電極と、前記第2基板の前記液晶層側の面に形成された半透過反射層と、該半透過反射層と前記液晶層との間に形成された透明な第2電極と、前記第2基板の前記液晶層と反射側に配置された照明装置と、該照明装置の点灯時と非点灯時とで前記第1及び第2電極を介して前記液晶層に印加さ

れる液晶駆動電圧が同一画像に対して相異なるように前記第1及び第2電極を駆動する駆動手段とを備えたことを特徴とする。

【00151】なお、第1及び第2液晶装置の駆動方式としては、パッシブマトリクス駆動方式、TFT (Thin Film Diode) アクティブマトリクス駆動方式、セグメント駆動方式の公知の各種駆動方式を採用可能である。また、表示モードとしては、ローワー・ブランクモードでもローワー・ホワイトモードのいずれでもよい。また、表示モードは、非駆動時には液晶装置が暗状態となるように駆動するので、透過型表示時に液晶が駆動されない画像領域またはドット間からの光漏れを抑えることができ、コントラストが高い透過型表示を得ることができる。また、反射型表示時には、画面間やドット間からの表示に不要な光を抑えることができるので、コントラストが向上し、表示を得ることができる。

【00161】本発明の第1及び第2の液晶装置の一の態様では、夫々、前記半透過反射層は、各画面側に前記照明装置からの光が透過可能な開口部が設けられた反射膜からなる。

【00171】この態様によれば、半透過反射層に設けられた開口部を介して、照明装置からの光が各画面側に透過可能であるので、照明装置を利用した透過型表示が可能となる。また、開口部から外れた反射膜部分により、液晶層を介して外光を反射するので、外光を利用した反射型表示が可能となる。なお、このような開口部としては例えば、反射膜の表面に規則的に配列された又は不規則に点在された矩形のスリットや線状の開口、孔、陥、凹入部等でもよい。若しくは、反射膜をストライ

プ状や島状に規則形成して、相隣接する反射膜の間隙を開口部として光が透過するように構成してもよい。また、反射膜の材料としては、Al (アルミニウム) が主成分の金属膜が用いられるが、Cr (クロム) やAg (銀) などの可視光線域の外光を反射させることのできる金属であれば、その材料は特に限定されるものではない。例えば、95重量%以上のAlを含み、かつ厚さが10nm以上40nm以下であるように反射膜を構成すれば、透過率が1%以上40%以下であり、反射率が50%以上95%以下である半透過反射型の反射電極が作製できる。

【00181】他方、開口部の径は、0.01μm以上20μm以下であることが好ましい。このようにすることで、人間が認識することが困難であり、開口部に設けたことで生じる液晶品質の劣化を抑えつつ、反射型表示と透過型表示を同時に実現できる。また、開口部は反射膜に対して、5%以上30%以下の面積比で形成することが好ましい。このようにすることで、反射型表示の明るさの低下を抑えることができると共に、反射膜の開口部を介して液晶層に導入される光によって透過型表示が実現できる。このような開口部はレジストを用いたフォトエッチング、工工程で容易に作製することができる。

【00191】特に、本発明の第1の液晶装置の場合には、このように反射膜からなる半透過反射層（第2電極）が外光を反射する機能と液晶に電圧を印加する機能との両方を有するので、反射膜と画素電極とを別設形成する場合と比較して、装置構成上も製造上最も設計上も有利であり、低コスト化を図れる。他方、本発明の第1の液晶装置の場合には、透明な第2電極に開口部を設ける必要がないため、当該第2電極についての装置信頼性や製造歩留まりが高まる。

【00201】本発明の第1及び第2の液晶装置の他の態様では、夫々、前記駆動手段は、前記第1電極に電圧を供給する第1供給手段と、該第1供給手段が供給する電圧を前記第2電極に印加して透過型表示用の電圧に切り換える前記第2電極に印加して透過型表示用の電圧に切り換えるように前記第1供給手段を制御する第1制御手段とを備える。

【00211】この態様によれば、第1供給手段（例えば、ドライバ回路）により、第1電極（例えば、走査線）に電圧が供給されるが、第1制御手段による制御の下、この供給される電圧は、照明装置の点灯時に応じて、反射型表示用の電圧に切り換えられ、他方で照明装置の点灯時に応じて透過型表示用の電圧に切り換えられる。従って、反射型表示時及び透過型表示時に、駆動電圧に対する反射率特性及び透過率特性に次々適合した駆動電圧により液晶を駆動できる。

【00221】この態様では、前記照明装置における前記点灯と前記非点灯とを切り換える点灯切替手段を更に備

えており、該点灯切換手段による切り換え動作に同期して前記第1制御手段は、前記第1供給手段が供給する電圧を反射型表示用の設定電圧又は透過型表示用の設定電圧に切り換えるように構成してもよい。

【0023】本発明の第1及び第2の液晶装置の他の態様では、夫々、前記駆動手段は、前記第2電極に電圧を供給する第2供給手段と、該第2供給手段が供給する電圧を前記非点灯に応じた透過型表示用の設定電圧に切り換え且つ前記点灯に応じた透過型表示用の設定電圧に切り換えるように前記第2供給手段を制御する第2制御手段とを備える。

【0024】この態様によれば、第2供給手段（例えば、Xドライブ回路）により、第1電極（例えば、データ線）に電圧が供給されるが、第1制御手段による制御の下、この供給される電圧は、照明装置の非点灯に応じて、反射型表示用の設定電圧に切り換えられ、他方で照明装置の点灯に応じて透過型表示用の設定電圧に切り換えられる。従って、反射型表示時及び透過型表示時に、駆動電圧に対する反射率特性及び透過率特性に夫々適合した駆動電圧により液晶を駆動できる。

【0025】この態様では、前記第2供給手段は、随時データの指示が階層レベルに応じた大きさの実効値を有する電圧を前記第2電極に供給し、前記第2制御手段は、各階層レベルに対して前記実効値の各大きさの設定を、前記非点灯に応じた反射型表示用の設定電圧に切り換え且つ前記点灯に応じた透過型表示用の設定電圧に切り換えるように前記第2供給手段を制御してもよい。

【0026】このように構成すれば、第2制御手段による階層の下、各階層レベルに対する実効値の各大きさの設定は、非点灯に応じて反射型表示用の設定電圧に切り換えられ、他方照明装置の点灯に応じて透過型表示用の設定電圧に切り換えられる。そして、第2供給手段により階層データの指示が階層レベルに応じた大きさの実効値を有する電圧が前記第2電極に供給される。従って、特に階層全層に渡って良好な駆動電圧により液晶を駆動できる。

【0027】本発明の第1及び第2の液晶装置の他の態様では、夫々、前記半透過反射層と前記第1基板との間には、カラーフィルタを更に備える。

【0028】この態様によれば、外光による反射型カラー表示と照明装置を利用した透過型カラー表示を行うことが可能である。カラーフィルタは、380nm以上780nm以下の波長範囲のすべての光に対して25%以上の透過率を有しているのが好ましい。このようにすることで、明るい反射型カラー表示と透過型カラー表示を実現できる。

【0029】本発明の第1及び第2の液晶装置の他の態様では、夫々、前記半透過反射層が凹凸を有する。

【0030】この態様によれば、反射電極の微面感を凸凹によってなくし、解像面（白色面）に見せることができる。また、凹凸による散乱によって、広視野角の表示

にラビング処理が施されている。

【0036】一方、後方の透明基板2の内面上には、上配カラーフィルタ5の着色層毎に形成されたストライプ状の反射電極7が上配透明電極6と交差するように複数配列されている。TFD素子やTFD素子を備えたアクティブマトリクス型の装置である場合には、各反射電極7は矩形状に形成され、アクティブ素子を介して配線に接続される。この反射電極7はC₁やA₁などにより形成され、その表面は透明基板1の面から入射する光を反射する反射面となっている。反射電極7の表面上には、上配と同様の配向膜19が形成される。反射電極7には、2μm程度の開口部7b（図1(b)参照）が多数設けられており、開口部7bの総面積は反射電極7の総面積に対して約10%の割合で設けられている。

【0037】ここで図2～図6を参照して、反射電極7及び開口部7bの各種の具体例について説明する。【0038】先ず図2に示すように、上側の透明基板1に形成されたストライプ状の透明電極802（図1の透明電極6に対応）に対して、下側の透明基板1に形成されたストライプ状の反射電極802（図1の反射電極7に対応）に、矩形のスリット803（図1の開口部7bに対応）が形成されてもよい。なお、矩形のスリット803は、正方形でも長方形でも、その他の多角形や円形でもよい。更に、配置や向き等についても、各ドット（即ち図2中、透明電極801と反射電極802とが交差する領域）内に少なくとも一つ一つの開口部が設けられていてもよい。規則正しく配列されてもよいし、不規則に点在されてもよい。

【0039】図3に示すように、上側の透明基板1に形成されたストライプ状の透明電極601（図1の透明電極6に対応）に対して、下側の透明基板1に形成されたストライプ状の反射電極602（図1の反射電極7に対応）に、不規則に点在する孔欠陥、凹入欠陥等の微細な欠陥部603（図1の開口部7bに対応）が形成されてもよい。

【0040】図4に示すように、上側の透明基板1に形成されたストライプ状の透明電極301（図1の透明電極6に対応）に対して、下側の透明基板1に形成されたストライプ状の反射電極303（図1の反射電極7に対応）を所定の間隔303（図1の開口部7bに対応）を隔てて配置してもよい。即ち、この間隔303を介してバックライト15からの光を液晶層3に導入する。

【0041】ここで第1実施形態は単独（パッシブ）マトリクス型液晶装置に保るものであるが、例えば後述するTFDアクティブマトリクス駆動方式の半透過反射型液晶装置の場合には、図4の具体例と同様の考え方が、図5に示すように、上側の透明基板1に形成されたストライプ状の透明電極201（図1の透明電極6に対応）に対して、下側の透明基板1に各ドット毎に形成された島状の反射電極204（図1の反射電極7に対

応）を所定の間隔205（図1の開口部7bに対応）を隔てて配置してもよい。即ち、この間隔205を介してバックライト15からの光を液晶層3に導入する。尚、この場合には、下側透明基板1には走査線202が形成され、さらに各ドットに対してTFD素子203が形成されて、TFD素子203を介して走査線202と反射電極204とが接続されている。

【0042】更に、例えば後述するTFDアクティブマトリクス駆動方式の半透過反射型の液晶装置の場合には、図4の具体例と同様の考え方が、図6に示すように、上側の透明基板1に形成された透明電極1401（図1の透明電極6に対応）に対して、下側の透明基板1に各ドット毎に形成された島状の反射電極1405（図1の反射電極7に対応）を所定の間隔1406（図1の開口部7bに対応）を隔てて配置してもよい。即ち、この開口部7bを介してバックライト15からの光を液晶層3に導入する。尚、この場合には、下側透明基板1には走査線1402及び走査線1403が形成され、さらに各ドットに対してTFD素子1404が形成されて、TFD素子1404を介して走査線1402及び走査線1403と反射電極1405とが接続されている。

【0043】再び図1(a)及び図1(b)に示すように、前方の透明基板1の外面上に偏光板11が配置され、偏光板11と透明電極1との間に位相板13が配置されている。また、液晶セルの後方には、透明基板2の背後に位相板14が配置され、この位相板14の背後に偏光板12が配置されている。そして、偏光板12の後方には、白色光を穿する透光層15aと、この透光層15aに貼った入射端面を備えた透光板15bとを有するバックライト15が配置されている。透光板15bは液晶全体に散乱用の粗面が形成され、或いは散乱用の印刷層が形成されたアクリル樹脂板などの透明体であり、光源である透光層15aの光を端面にて受けて、図の上面からほぼ均一な光を放出するように構成されている。その他のバックライトとしては、LED（発光ダイオード）やEL（エレクトロルミネセンス）などを用いることができる。

【0044】第1実施形態では、透過型表示のときに各反射電極7の間の領域7aから光が漏れるのを防ぐために、カラーフィルタ5の各色層の間に形成された透光部であるブラックマトリクス層5aが平面的にほぼ対応して設けられている。ブラックマトリクス層5aはCr層を被覆したり、感光性ブラック樹脂で形成する。

【0045】次に以上のように構成された第1実施形態の動作について説明する。

【0046】先ず、反射型表示について説明する。外光は図1における偏光板11、位相板13、カラーフィルタ5をそれぞれ透過し、液晶層3を通過後、反射電極7によって反射され、再び偏光板11から出射される。

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このとき、液晶層3への印加電圧に依りて、偏光板11の透過（明状態）及び吸収（暗状態）並びにそれらの中間の明るさを制御する。

100471 次に、透過型表示について説明する。バックライト15からの光は偏光板12及び位相差板14によって所定の偏光となり、反射電極7の開口部より液晶層3に導入され、液晶層3を通過後、カラーフィルタ5、位相差板13をそれぞれ透過する。このとき、液晶層3への印加電圧に依りて、偏光板11の透過（明状態）及び吸収（暗状態）並びにそれらの中間の明るさを制御する。

100481 ここで、図7に示したように、第1実施形態の如き半透過反射型の液晶装置においては、一般に、駆動電圧に対する反射型表示時の反射率Rの特性と透過型表示時の透過率Tの特性とは、相異なるものであることが本発明者らによる研究及び実験の結果判明している。即ち、仮にバックライト15の点灯と非点灯とによる、同一画素に対して、一定の駆動電圧でこの種の半透過反射型の液晶装置を駆動しようとするは、反射型表示時及び透過型表示時のどちらか一方についてしか、高防漏表示を行うため或いはコントラストを高めるために図7に示した如き特性曲線のスロープを最大限に利用することができないことになる。しかるに、本実施形態では、バックライト15の点灯時と非点灯時とは、透明電極6と反射電極7を介して液晶層3に印加される液晶電圧が同一画素に対して相異なるように、透明電極6と反射電極7が駆動される。即ち、本実施形態では、バックライト15を非点灯した反射型表示時には、図7に示したような反射率Rの特性に適合した駆動電圧により液晶層3が駆動され、バックライト15を点灯した透過型表示時には、図7に示したような透過率Tの特性に適合した駆動電圧により液晶層3が駆動される。特に、白表示と黒表示の中間表示をするための液晶印加電圧のレベルを反射型表示と透過型表示で変えることは非常に有用である。これらの反射率Rの特性に適合する駆動電圧の設定及び透過率Tの特性に適合する駆動電圧の設定は、両方、個々の液晶装置について各駆動電圧毎の反射率Rの特性及び透過率Tの特性を予め実験的、経験的、理論的に求めておくことにより比較的容易に可能である。尚、このような駆動を行う駆動装置の具体的な構成については第3実施形態として詳述する。

100491 上述した本実施形態によれば、二重切りや表示のじみのない反射型表示と透過型表示とを切り換えて表示することができ、特に反射型表示と透過型表示とのいずれにおいても高コントラストで高品位のカラー液晶装置が実現できる。

100501 尚、第1実施形態によれば、偏光板11及び12により反射型表示と透過型表示とのいずれにおいても良好な表示制御ができる。そして、位相差板13により反射型表示時における光の波長分散に起因する色付

きなどの色偏への影響を低減すると共に、位相差板14により透過型表示時における光の波長分散に起因する色付きなどの色偏への影響を低減することが可能となる。また、位相差板13及び14については、液晶層の着色や偏光、もしくは偏角制御によりそれぞれの位置に複数枚位相差板を配置することも可能である。

100511 更に、上述した本実施形態では、反射電極7を平坦ではなく、例えば高低差が約0.8μmの凹凸を有するように構成してもよい。このように構成すれば、反射電極17の表面を凹凸によって凹凸と平坦面（白色面）に見せることができ、凹凸による散乱によって広視野角の表示が可能となる。他方、位相差板13と透明基板1との間に、アクリル樹脂などの透明媒体中に屈折率の異なる透明な粒子を分散させた内部散乱体のもので、透明媒体の表面とを粗面化（ペット化）した表面散乱体のもので粗面化（ペット化）した表面散乱体により、このように構成すれば、反射電極7の表面反射による外光の映り込みを抑制し、視認性を向上させることができる。更に、反射電極7に、蒸着やスパッタリング、フォトリソグラフィ工程等を利用して微細な凹凸を多数形成してもよく、これにより透過型表示を行う際に表示を明るくでき、反射型表示を行う際に外光の映り込みを防止できる。

100521（第2実施形態） 本発明に係る液晶装置の第2実施形態を図8及び図9を参照して説明する。図8は、本発明の第2実施形態の構造を示す縦断断面図であり、図9(a)は、第2実施形態に係る反射電極の一例を示す拡大平面図であり、図9(b)は、この反射電極の他の例を示す拡大平面図である。図8中、図1に示した第1実施形態と同じ構成要素については同じ参照符号を付し、その説明は省略する。尚、この実施形態は基本的に単純マトリクス型の液晶表示装置に関するものであるが、同様の構成によりアンプマトリクス型の装置や他のセグメント型の装置、その他の液晶装置にも適用することは可能である。

100531 図8に示すように、第2実施形態では、第1実施形態と比べると、下側基板1上の第2電極が開口部を有する単一層の反射電極ではなく、開口部を有する半透過反射板上に設けられた透明電極からなる（即ち、第1電極は電極機能のみを果たし、別途設けられた反射膜が半透過電極機能を果たす）点が異なる。更に、カラーフィルタ及びガラスマトリクス層が下側基板1上に設けられていてる点等が主に異なる。その他の構成については基本的に第1実施形態の場合と同様である。

100541 即ち図8に示すように、透明基板1側では、配向膜19には所定方向にラビング処理が施されており、液晶分子はベント方向に約85度の傾斜を有している。TFD素子とTFT素子を備えたアンプマトリクス型の装置である場合には、透明電極6は矩形状に形成され、アンプマトリクス素子を介して記録に

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接続される。

100551 一方、下側の透明基板2の内面には、感光性のアクリル樹脂によって形成された約0.8μmの凹凸が形成されており、その表面上に、0重量%のNDを添加したA1を5nmの厚みでスパッタし、半透過反射板411が形成されている。半透過反射板411上には、保護膜412を介して、カラーフィルタ414が形成され、このカラーフィルタ414には、R（赤）、G（緑）、B（青）の3色の着色層が所定パターンで配列されている。カラーフィルタ414の表面には透明なストライプ状の透明電極416がITOなどにより形成されている。カラーフィルタ414の着色層毎に形成されたストライプ状の透明電極416が上記透明電極6と交差するように複数配列されている。透明電極416の表面上には上記と略同の配向膜19が形成される。なお、この配向膜19にはラビング処理を施さない。位相差板13及び14として、特に1/4波長板が夫々用いられる。

100561 更に第2実施形態では、偏光板11と偏光板12の透過軸P1及びP2は同一方向に設けられている。これらの偏光板11及び12の透過軸P1及びP2に対して、位相差板（即ち、1/4波長板）13及び14の遅延軸方向は、θ=45度時基方向に回転した方向に設定されている。さらに、透明基板1の内面上の配向膜9のラビング処理の方向R1もまた、位相差板（即ち、1/4波長板）13及び14の遅延軸C1及びC2の方向と一致する方向に施されている。このラビング方向R1は、液晶層3の電界印加時における得られる方向を規定する。液晶層3には、誘電異方性が負のネグティブ液晶を用いる。

100571 更に第2実施形態では、透過型表示のときに各ドット間の隙間から光が漏れるのを防ぐために、カラーフィルタ414の各色層の間に形成された遮光部であるブラックマトリクス層413が平坦的にほぼ対応して設けられている。ブラックマトリクス層413はC1層を被覆したり、感光性ブラック樹脂で形成する。

100581 以上のように構成された第2実施形態の液晶装置における駆動電圧に付する反射型表示時の反射率Rの特性と透過型表示時の透過率Tの特性とは、図7に示した第1実施形態の場合と同様の傾向を示す。尚、第2実施形態の液晶装置を駆動する際には、電界無印加時の表示状態は暗（黒）である。このようにノーマリーブラックモードで駆動すれば、液晶が駆動されない透明電極416の間隙からの光漏れや不要な反射光を抑えることができるので、ブラックマトリクス層413を形成する必要がない。

100591 次に以上のように構成された第2実施形態の動作について説明する。

100601 先ず、反射型表示について説明する。外光

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は図8における偏光板11、位相差板13をそれぞれ透過し、液晶層3を通過後、カラーフィルタ414を透過し半透過反射板411によって反射され、再び偏光板11から出射される。このとき、液晶層3への印加電圧に依りて、偏光板11の透過（明状態）及び吸収（暗状態）並びにそれらの中間の明るさを制御する。

100611 次に、透過型表示について説明する。バックライト15からの光は偏光板12及び位相差板14によって所定の偏光（円偏光、楕円偏光又は直線偏光）となり、半透過反射板411より液晶層3に導入され、液晶層3を通過後、位相差板13を透過する。このとき、液晶層3への印加電圧に依りて、偏光板11の透過（明状態）及び吸収（暗状態）、及びその中間の明るさを制御することができる。

100621 ここで、第1実施形態の場合と同様に、第2実施形態においても、バックライト15の点灯時と非点灯時では、透明電極6と透明電極416を介して液晶層3に印加される液晶駆動電圧が同一画素に対して相異なるように、透明電極6と透明電極416が駆動される。即ち、本実施形態では、バックライト15を非点灯した反射型表示時には、図7に示したような反射率Rの特性に適合した駆動電圧により液晶層3が駆動され、バックライト15を点灯した透過型表示時には、図7に示したような透過率Tの特性に適合した駆動電圧により液晶層3が駆動される。尚、このよう駆動を行う駆動装置の具体的な構成については第3実施形態として詳述する。

100631 上述した本実施形態によれば、二重切りや表示のじみのない反射型表示と透過型表示とを切り換えて表示することができ、特に反射型表示と透過型表示とのいずれにおいても高コントラストで高品位のカラー液晶装置が実現できる。

100641 更に、第2実施形態の半透過反射板411にはA1が主成分の金属層を用いて、この表面を保護膜で覆い、その上にカラーフィルタ層や保護膜、透明電極を形成している。このため、A1金属層が直交ITO現像液やカラーフィルタ現像液と触れることがないので、A1金属層が現像液中で溶解することがない。さらに、傷が付きやすいA1金属層を取り扱いやすくなることで、1.0重量%のNDを添加した2.5mm厚のA1は、反射率80%及び透過率100%の値を示し、半透過反射板411として十分に機能していることが確認できる。

100651 また、凹凸を付与した半透過反射板411は、反射光を外に反射させることができるので、広視野角の液晶装置が実現できる。

100661 ここで、開口部を有する半透過反射板411及びこの上に設けられる透明電極416についての具体例を図9を用いて説明する。

100671 先ず第1の具体例では、図9(a)に示すように、上側の透明基板にITO等から形成されたストライ

【0071】また、本実施形態のA1反射層はその表面にITO透明電極を形成して、A1反射層に傷がつきにくくすることができ、またA1反射層ITO透明電極の2つが電極ラインとなるので、電極ラインの低抵抗化が可能となる。

【0072】(第3実施形態) 次に、上述した本発明の第1及び第2実施形態の液晶装置を駆動する駆動回路を含む液晶装置に係る第3実施形態について図10のブロック図を参照して説明する。

【0073】図10において、液晶パネル103に配備されたデータ線を駆動する第2供給手段の一例としてのXドライバ回路110、Xドライバ回路110の駆動電圧を制御する第2制御手段の一例としてのデータ線駆動回路110a、液晶パネル103に配備された走査線を駆動する第1供給手段の一例としてのYドライバ回路100及びYドライバ回路100における走査線駆動電圧を制御する第1制御手段の一例としての走査線駆動回路100aを備えて構成されている。データ線駆動回路110aは、画像信号Sv及び表示制御信号Saが外部の画像信号処理回路から入力されると、これらの入力信号に基づいてXドライバ回路110に対して、Xドライバ回路110は、画像信号Svを所定タイミングで各データ線に供給することにより、各データ線を駆動する。走査線駆動回路100aは、表示制御信号Saが外部の画像信号処理回路から入力されると、この入力信号に基づいてYドライバ回路100に対して走査線駆動回路100は、走査信号を所定タイミングで各走査線に供給することにより、各走査線を駆動する。

【0075】バックライト15及び光源駆動装置108【0076】点灯切換装置107は、点灯切換手段の一例を構成しており、バックライト15の点灯・非点灯操作者によるマニピュレーション操作により取り外し可能な透明電極602'のライオン(W2)を56μmとすると、液晶層に導入された外光のうち約70%を反射し、バックライトから出射し、下側の透明基板に導入された光のうち約10%を透過させることができる。

【0070】図9(a)の具体例におけるITOからなる透明電極601'のライン幅(L)を198μm、下側透明電極601'からなる反射層602'のライン幅(W)を46μm、その上に形成したITOからなる透明電極603'のライン幅(W2)を56μmとすると、液晶層に導入された外光のうち約70%を反射し、バックライトから出射し、下側の透明基板に導入された光のうち約10%を透過させることができる。

【0069】図9を用いて説明した具体例では、透明電極またはドット電極以外に入射した光は、表示に関係がなく、透過型表示のコントラストを低下させるだけであるので、遮光膜(プラズマトリクス層)や液晶層の表示モードをノーマリブランクとすることで、遮断することが好ましい。

【0070】図9(a)の具体例におけるITOからなる透明電極601'のライン幅(L)を198μm、下側透明電極601'からなる反射層602'のライン幅(W)を46μm、その上に形成したITOからなる透明電極603'のライン幅(W2)を56μmとすると、液晶層に導入された外光のうち約70%を反射し、バックライトから出射し、下側の透明基板に導入された光のうち約10%を透過させることができる。

【0079】以上説明したように第3実施形態によれば、半透過反射型の液晶装置においては一般に駆動電圧に対する反射型表示時の反射率Rの特性と透過型表示時の透過率Tの特性とは、相異なるものであるにも係わらず、図7に示した如き反射率R及び透過率Tの特性曲線、夫々のスロープを最大限に利用して、反射型表示にも透過型表示にも高階調表示を行うことができ、コントラストを高めることができる。特に、白表示と黒表示の中間調表示を与えるための液晶印加電圧のレベルを反射型表示と透過型表示で変えることは非常に有用である。

【0080】上述した本実施形態によれば、二重映りや表示のしじみのない反射型表示と透過型表示とを切り換えて表示することができ、特に反射型表示と透過型表示とのいずれにおいても高コントラストで高品位のカラー液晶装置が実現できる。

【0081】(第4実施形態) 本発明に係る液晶装置の第4実施形態を図11から図14を参照して説明する。第4実施形態は、本発明が好適に適用されるTFDアクティブマトリクス液晶装置の第4実施形態である。

【0082】先ず、本実施形態に用いられる2端子型非線形素子の一例としてのTFD駆動素子付近における構成について図11及び図12を参照して説明する。ここで、図11は、TFD駆動素子を面素電極等と共に模式的に示す平面図であり、図12は、図11のB-B'断面図である。尚、図12においては、各層や各部材を断面上で略図可能な程度の大きさとするため、各層や各部材に縮尺を異ならしめてある。

【0083】図11及び図12において、TFD駆動素子40は、透明基板2上に形成された絶縁膜41を下地として、その上に形成されており、絶縁膜41の側から順に第1金属膜42、絶縁層44及び第2金属膜46から構成され、TFD構造(Thin Film Diode)或いはIM構造(Metal Insulator Metal構造)を持つ。そして、TFD駆動素子40の第1金属膜42は、透明基板2上に形成された非蒸着膜61に接続されており、第2金属膜46は、第2電極の他の一例である導電性の反射層からなる面素電極62に接続されている。尚、走査線61に代えてデータ線(後述する)を透明基板2上に形成し、面素電極62に接続して、走査線61を方向基板側に設けてもよい。

【0084】透明基板2は、例えばガラス、プラスチックなどの絶縁性及び透明性を有する基板等からなる。下

【0071】また、本実施形態のA1反射層はその表面にITO透明電極を形成して、A1反射層に傷がつきにくくすることができ、またA1反射層ITO透明電極の2つが電極ラインとなるので、電極ラインの低抵抗化が可能となる。

【0072】(第3実施形態) 次に、上述した本発明の第1及び第2実施形態の液晶装置を駆動する駆動回路を含む液晶装置に係る第3実施形態について図10のブロック図を参照して説明する。

【0073】図10において、液晶パネル103に配備されたデータ線を駆動する第2供給手段の一例としてのXドライバ回路110、Xドライバ回路110の駆動電圧を制御する第2制御手段の一例としてのデータ線駆動回路110a、液晶パネル103に配備された走査線を駆動する第1供給手段の一例としてのYドライバ回路100及びYドライバ回路100における走査線駆動電圧を制御する第1制御手段の一例としての走査線駆動回路100aを備えて構成されている。データ線駆動回路110aは、画像信号Sv及び表示制御信号Saが外部の画像信号処理回路から入力されると、これらの入力信号に基づいてXドライバ回路110に対して、Xドライバ回路110は、画像信号Svを所定タイミングで各データ線に供給することにより、各データ線を駆動する。走査線駆動回路100aは、表示制御信号Saが外部の画像信号処理回路から入力されると、この入力信号に基づいてYドライバ回路100に対して走査線駆動回路100は、走査信号を所定タイミングで各走査線に供給することにより、各走査線を駆動する。

【0075】バックライト15及び光源駆動装置108【0076】点灯切換装置107は、点灯切換手段の一例を構成しており、バックライト15の点灯・非点灯操作者によるマニピュレーション操作により取り外し可能な透明電極602'のライオン(W2)を56μmとすると、液晶層に導入された外光のうち約70%を反射し、バックライトから出射し、下側の透明基板に導入された光のうち約10%を透過させることができる。

【0070】図9(a)の具体例におけるITOからなる透明電極601'のライン幅(L)を198μm、下側透明電極601'からなる反射層602'のライン幅(W)を46μm、その上に形成したITOからなる透明電極603'のライン幅(W2)を56μmとすると、液晶層に導入された外光のうち約70%を反射し、バックライトから出射し、下側の透明基板に導入された光のうち約10%を透過させることができる。

【0069】図9を用いて説明した具体例では、透明電極またはドット電極以外に入射した光は、表示に関係がなく、透過型表示のコントラストを低下させるだけであるので、遮光膜(プラズマトリクス層)や液晶層の表示モードをノーマリブランクとすることで、遮断することが好ましい。

【0070】図9(a)の具体例におけるITOからなる透明電極601'のライン幅(L)を198μm、下側透明電極601'からなる反射層602'のライン幅(W)を46μm、その上に形成したITOからなる透明電極603'のライン幅(W2)を56μmとすると、液晶層に導入された外光のうち約70%を反射し、バックライトから出射し、下側の透明基板に導入された光のうち約10%を透過させることができる。

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地をなす絶縁膜41は、例えば酸化タンタルからなる。但し、絶縁膜41は、第2金属膜46の堆積後等に行われる熱処理により第1金属膜42が下地から剝離しないこと及び下地から第1金属膜42に不純物が拡散しないことを主目的として形成されるものである。従って、透明基板2を、例えば石英基板等のように無熱性や低膨張に優れた基板から構成することにより、これらの利便や不純物の拡散が問題とならない場合に、絶縁膜41は省略することができる。第1金属膜42は、導電性の金属膜からなり、例えば、タンタル膜又はタンタル合金からなる。絶縁膜44は、例えば化成膜中で第1金属膜42の表面に陽酸化により形成された酸化膜からなる。第2金属膜46は、導電性の金属膜からなり、例えば、クロム膜又はクロム合金からなる。

100851 本実施形態では特に、面素電極62は、上述した各実施形態のように長方形や正方形のグリッド、微細な開口等の光が透過する領域が設けられているか或いは、面素電極に對向基板上の透明電極より小さく形成されてその間隙を介して光が透過可能に構成されている。また、面素電極62は、単一の反射膜から構成されてもよい。反射膜と透明電極層との積層体から構成されてもよい。

100861 更に、面素電極62、TFD駆動素子40、走査線61等の部品に面する側(図4上側面)には、透明絶縁膜29が設けられており、その上に例えばポリイミド層などの有機膜層からなりラミネート処理等の所定の配向処理が施された配向膜19が設けられている。

100871 以上、2端子型非線形素子としてTFD駆動素子の幾つかの例について説明したが、ZnO(酸化亜鉛)バリスタ、MSI(Metal Semi-Insulator)駆動素子、RD(Ring Diode)などの双方向ダイオード特性を有する2端子型非線形素子を本実施形態の反射型液晶装置に適用可能である。

100881 次に、以上に構成されたTFD駆動素子を備えて構成される第4実施形態であるTFDアクティブマトリクス駆動方式の半透過反射型液晶装置の構成及び動作について図13及び図14を参照して説明する。ここに、図13は、液晶素子を駆動回路と共に示した等価回路図であり、図14は、液晶素子を模式的に示す部分接続回路図である。

100891 図13において、TFDアクティブマトリクス駆動方式の半透過反射型液晶装置は、透明基板2上に配列された複数の走査線61が、第1供給手段の一例を構成するYドライバ回路100に接続されており、その対向基板2上に配列された複数のデータ線60が、第2供給手段の一例を構成するXドライバ回路110に接続されている。尚、Yドライバ回路100及びXドライバ回路110は、透明基板2又はその対向基板2上に形成されていてもよく、この場合には、駆動回路内蔵型の半透

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透反射型液晶装置となる。或いは、Yドライバ回路100及びXドライバ回路110は、半透過反射型液晶装置とは独立した外部ICから構成され、所定の記録を記憶した走査線61やデータ線60に接続されてもよく、この場合には、駆動回路を含まない半透過反射型液晶装置となる。

100901 トリクス状の各面素電極において、走査線60は、TFD駆動素子40の一方の端子に接続されており(図11及び図12参照)、データ線60は、液晶層3及び面素電極62を介してTFD駆動素子40の他方の端子に接続されている。従って、各面素電極に對應する走査線61に駆動信号が供給され、データ線60にデータ信号が供給されると、当該面素電極におけるTFD駆動素子40がオン状態となり、TFD駆動素子40を介して、面素電極62及びデータ線60間にある液晶層3に駆動電圧が印加される。そして、明所では外光を面素電極62が反射することにより反射型液晶が行われ、暗所ではバックライトからの光源光を面素電極62の開口部が透過することにより透過型液晶が行われる。

100911 図14において、半透過反射型液晶装置は、透明基板2と、これに外向配置される透明基板(対向基板)1とを備えている。透明基板1は、例えばガラス基板からなる。透明基板2には、トリクス状に面素電極62が設けられており、各面素電極62は、走査線61に接続されている。透明基板1には、走査線61と交差する方向に伸びており、矩形状に配列された透明電極としての複数のデータ線60が設けられている。データ線60は、例えばITO(Indium Tin Oxide)膜などの透明導電性薄膜からなる。走査線60の下側には、例えばポリイミド層などの有機膜層からなりラミネート処理等の所定の配向処理が施された配向膜19が設けられている。更に、透明基板1には、その用途に応じて、ストライプ状、モザイク状、トライアングル状等に配列された色材膜からなる不図示のカラーストライプが設けられる。

100921 以上説明したように、第4実施形態のTFDアクティブマトリクス駆動方式の半透過反射型液晶装置によれば、二重映や表示のにじみのない反射型表示と透過型表示とを切り換え表示することによってカラー液晶装置が実現でき、画像データの格納レベルに対する駆動電圧の設定を反型表示時と透過型表示時とで切り換えることにより、反射型表示時にも透過型表示時にも高コントラストで高品位の画像表示が行える。特に駆動手段の一例を構成するX及びYドライバ回路110及び100における電圧制御により半透過反射型液晶装置をローマニングラングワンモードで駆動できる。

100931 (第5実施形態) 次に、図13に示したYドライバ回路110及びXドライバ回路110を含む、上述したTFDアクティブマトリクス駆動方式の半透過反射型の液晶装置を駆動する駆動装置に係る一の実施形態における構成及び動作について図15から図19を参照して説明する。尚、図15は、駆動装置の具体的な構成を示すブロック図であり、図16は、第1GCP信号及び第2GCP信号の波形状であり、図17は、Xドライバ回路における一本のデータ線を駆動する部分のブロック図であり、図18は、駆動装置における各種信号の波形及び時間的関係を示すタイミングチャートである。図19は、各階層レベルに對する1H期間中の一面素への印加電圧のレベルの変化を示す特性図である。

100941 図15に示すように、駆動装置は、階層データ(表示データ)の示す階層レベルに応じた大きさの駆動電圧を有する印加電圧を液晶素子(駆動回路を除く液晶装置の本体部分)に供給する第1及び第2供給手段の夫々一例であるYドライバ回路110及びXドライバ回路110を備える。駆動装置は、Xドライバ回路110における各階層レベルに對するデータ信号の各レベル幅の設定を切り換えることにより、各階層レベルに對する印加電圧の実効値の大きさの設定を光源ランプ212aの非点灯に應じて反射型表示用の設定に切り換え、且つ光源ランプ212aの点灯に應じて透過型表示用の設定に切り換える第2制御手段の一例を構成するドライバコントロール回路310と、Yドライバ回路100及びXドライバ回路110に所定の高電位、低電位、基準電位の制御電圧を供給する制御電力供給回路320と、光源ランプ212bの点灯及び非点灯(消灯)を制御する点灯制御回路330とを更に備える。

100951 ドライバコントロール回路310は、後述のようにXドライバ回路110における階層レベルに應じたレベル幅のデータ信号を生成する際のレベル幅の基準となる第1GCP(グレースケールコントロール)信号及び第2GCP信号を夫々生成する第1GCP生成回路311及び第2GCP生成回路312と、RGBの階層データが入力されると所定フーバーのデータ信号に渡換してXドライバ回路110に出力するデータ信号、水平同期信号等の各種の制御信号、タイミング信号等が入力され、第1及び第2GCP生成回路311及び312に對する第1及び第2GCP信号の生成タイミングを制御するLCD駆動信号を生成するLCD駆動回路314とを備えて構成される。

100961 第1GCP生成回路311は、上述の反射型表示用のレベル幅の設定の基準となる、階層レベルのデータに對して配列された複数のレベルからなる第1GCP信号を生成する。

100971 第2GCP生成回路312は、上述の透過型表示用のレベル幅の設定の基準となる、階層レベルのデータに對して配列された複数のレベルからなる第2GCP信号を生成する。

100981 図16に示すように、第1及び第2GCP信号は、相互に異なるレベル配列を有しており、第1G

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C信号に基づいてXドライバ回路110から供給されるデータ信号と第2GCP信号に基づいてXドライバ回路110から供給されるデータ信号とでは、同一の階層データに對するレベル幅が異なる。第1及び第2GCP信号は、N階層の階層データの場合に、夫々階層レベル(1)を表示するためのデータ信号のレベル幅に對するレベルから階層レベル(N-1)を表示するためのデータ信号のレベル幅に對するレベルまで、各N-2本のレベルからなり、レベル間幅が階層レベルの刻みに對するようになら配列されている。

100991 このような第1及び第2GCP生成回路311及び312は夫々、例えば、複数の比較回路及びこれらの比較結果の論理和を演算する論理回路から構成されており、これらの比較回路により、LCD駆動信号の電圧値を、予め階層レベルの刻みに對するレベル幅の変化幅に應じて反射型表示用又は透過型表示用に設定された複数の階層レベルの電圧値と比較する。そして、これらの比較回路の比較結果の論理和を演算することにより、その演算出力として、各階層レベルの刻みに應じたレベル幅の変化幅に對して階層幅が異なる1選択期間当たりN-2個のレベルの所からなる図16に示したような第1及び第2GCP信号を生成するように構成されている。

101001 再び、図15において、ドライバコントロール回路310は、このように第1及び第2GCP信号のうちいずれかを選擇的にXドライバ回路110に供給するレベル幅をスイッチ315を更に備える。そして、レベル幅をスイッチ315は、点灯制御回路330に用いる点灯スイッチ331を用いた点灯制御に同期して、第1GCP信号を供給すると共に、点灯制御回路330による点灯スイッチ331を用いた点灯制御に同期して、第2GCP信号を供給するように、レベル幅をスイッチ315を切り換える。尚、点灯制御回路330による点灯及び非点灯制御は、例えば、使用量によるモニタリング操作や、外光強度を検出して、その検出結果に基づいて自動スイッチ操作により行われる。すると、この点灯及び非点灯制御に同期して、レベル幅をスイッチ315が切り換えられる。従って、光源ランプ212aの点灯及び非点灯制御に應じて、液晶装置に且つ遅延なく反射型表示用の設定と透過型表示用の設定とに切り換えることができる。

101011 尚、このようなレベル幅をスイッチ315における切り換え動作は、図15に示したように点灯制御回路330から点灯スイッチ315に送られる点灯制御信号Smodeに基づいて行うように構成してもよいが、光源ランプ212aが点灯又は消灯されたことを検出する検出器からの検出信号に基づいて行うように構成してもよい。

101021 図15において、制御電力供給回路320は、Xドライバ回路110がデータ信号生成のために用

る。そして、制御電圧スイッチ325は、光線ランプ212aの非点灯時に応じて、第1制御電圧をドライバ回路100に選択的に供給し、光線ランプ212aの点灯時に応じて第2制御電圧をドライバ回路100に選択的に供給するように構成されている。

【0124】従って、第6実施形態では、Xプロパティ・パ
ス110により、階層レベルに応じたパス幅を有する
データ番号が、データ線に供給される。これと並行
して、Yプロパティ・パス100により、所定幅を有すると共
に、第1又は第2制御電圧に対応する放電値を持つ走査信
号が垂直線に供給される。

【0125】図21は、このように生成された2種類の
走査信号の一例の波形図である。

10126) 図 1 において、第 1 制御電圧に基づいて生成される反転制御電圧に設定される走査信号(図中、左側)と、第 2 制御電圧に基づいて生成される逆走査電圧(図中、右側)とでは、後者の電圧値が、前者の電圧値よりも、 ΔV だけ高い。従って、ノーマリ・ドライキエード下では、逆走査電圧時の走査信号により駆動した場合の方が、印加電圧の電圧値は、 ΔV だけ大きいため、表示の明るさは暗くなる。即ち、反転電圧示の走査信号により駆動した場合の方が、印加電圧の電圧値が ΔV だけ小さいため、表示の明るさは明るくなる。

[0127] 従って、閉鎖レベルと反射型表示における反射率との関係を、図7に示した駆動電圧に対する透過率 T の特性に適合した関係、即ち、透過率 T の特性曲線のスローを最大限に利用できるように、各閉鎖レベルに対する第2の閉鎖電圧の設定（具体的には、電圧 V_{H2} 、 V_{L2} 、 V_{CH2} の値の設定）を行えば、透過型表示時のコントラストを効率的に高められる。同時に、図7に示した駆動電圧に対する透過率 T の特性に適合した関係、即ち、反射率 R の特性曲線のスローを最大限に利用する関係とるように、各閉鎖レベルに対する第1の閉鎖電圧の設定（具体的には、電圧 V_{H1} 、 V_{L1} 、 V_{CH1} の値の設定）を行えば、反射型表示時のコントラストを効率的に高められる。

[0128] 以上説明したように、第6製造形態の液晶装置によれば、母素による二酸化珪素や酸素に高コンタクトで露出する反転型表示時に透過型表示時に高コンタクトで露出する画層表示が可能となる。尚、具体的な第1及び第7制御電圧を構成する電圧V_{VH1}、V_{L1}、V_{CV1}、V_{H2}、V_{L2}及びV_{CV2}の各値については、液晶装置について予め実験的・理論的シミュレーション等により求められ、また、選択期間毎に印加電圧を反転させる駆動方式を採用する場合には、高電位の電圧V_{VH1}(V_{H2})と低電位の電圧V_{L1}(V_{L2})と差押えられた電圧V_{VCV1}(V_{VCV2})が必要であるが、図2に示したような高値をとり続けられる限りにおいて、第1の制御電圧と第2の

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るを防ぐために、画素電極6.2と対向電極との間に形成される液晶容量と並列に蓄積容量1.70を付加する。

[0133] 図2.3に示れて、TFTアレイ基板としての透明基板2上には、 π トリス状に区別膜からなる画素電極6.2（その輪郭2.2aが図中点線で示されてい

り、走査線1.31とデーク線1.35との交差する箇所には夫々、デーク線側81 a、1走査線1.31がデーク線として対応配置されたFT1.30が配けられてゐる。

101341 図24に示すように、液晶装置は、透明基板2と、これに両面配置された透明基板(反射基板)1とを備えている。これらの透明基板1及び2は、例えば石英、ガラス、プラスチックなどの絶縁体及び透明性を有する基板からなる。

101345 本発明形態では特に、面取電極6は、上述した各異形状のようには長方形や正方形のマトリツ、密接な開口部が光が透過する領域に設けられている。あるいは、面取電極は、対向基板1上の透明電極よりも小さく形成されて、その面取電極を介して光が透過可能に構成されている。また、面取電極6は、単一の反射膜から構成されてもよいし、反射層と透明面取電極との積層膜から構成されてもよい。

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【0138】 面基板2に、各素子電極6に接続する位置に、各面電極6をインツチン接続する面素子チップ用FT130が設けられている。

【0139】 このように構成し、面電極6と2と対向し、1及び2と対面する一対の面電極基板1及び2との間には、第1実効形態の場合と同様にシール材によって囲まれた空間に液晶が封入され、液晶層3が形成される。

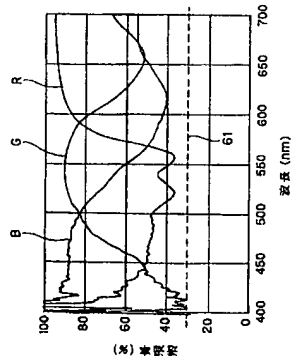
101401 更に、複数の面素スライディング用 F T F 3
0 の下に、第 1 層面素 F T F 12 が取付けられて形成さ
れることにより、面素スライディング用 F T F 30 のための
下地膜として構成する。第 1 層面素 F T F 12 は、例え
ば、NSG (ノド-アゾビケトンガラス)、PSG
(リン酸ニオブガラス)、BSG (ホロリンケトン
ガラス)、BPSG (ホロリンケトンガラス) な
どの高純度酸化ガラス又は、酸化シリコン膜、窒化シリ
コン膜等からなる。

[0101] 図2.4において、面素ヌイデング用TF 13.301は、コンタクトホルム8を介してケーブル13.5に接続され、コンタクトホルム8を介してケーブル13.1にケーブル13.2が接続される。ケーブル13.2は、ケーブル13.1の一端に接続され、ケーブル13.1の他端に接続される。ケーブル13.1は、A1等の低抵抗な金属層や金属ツライド等の合金層などを含む光導波路と導波路の複合体から構成されている。また、その上には、コンタクトホルム8及び8が開孔された第2層間絶縁膜114が形成されており、更に、その上には、コンタクトホルム8の開孔された第3層間絶縁膜117が形成される。これら第2及第3層間絶縁膜114及び117についても、第1層間絶縁膜112と同様に、NSG、PSG、BSG、B PSGなどの高誘電率透明誘電性ガラス又は、酸化シリコン膜、窒化シリコン膜等からなる。

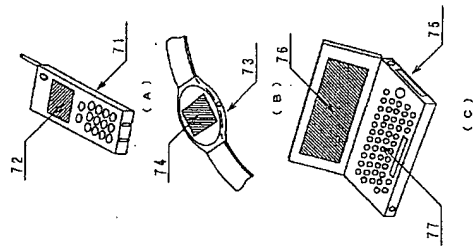
【0142】画素スイッチング用FT1301は、LD D構造、オフセット構造、セルプラズマ構造等いずれの構造のTFでもあってもよい。更に、シングルゲートの構造の他、デュアルゲート或いはトリプルゲート以上でTF130を構成してもよい。

【0146】以上の如く構成された第7実施形態のTF-T7トラフ・アトラフ駆動方式の半導体集積回路型の液晶装置は、Xトラフ・回路および走査線13が駆動される、Yトラフ・回路およびデータ線13が駆動されるが、この間、照明装置の点灯時と非点灯時では、対向電極121及び面素電極62（図24参照）を介して相違電圧3に供給される液晶分子層122に対して相異なるように、これらの対向電極121及び面素電極62が駆動される。即ち、データ線13に供給される面素電極131に供給される駆動電圧のうちの一方の電圧と面素電極131に供給される駆動電圧において、照明装置の

【図 25】



【図 26】



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CLAIMS

[Claim(s)]

[Claim 1] The 1st and 2nd substrates of a transparent pair, and the liquid crystal layer pinched between these 1st and 2nd substrates, The 1st transparent electrode formed in the field by the side of said liquid crystal layer of said 1st substrate, and the 2nd electrode which consists of a transfective reflection layer formed in the field by the side of said liquid crystal layer of said 2nd substrate, Said liquid crystal layer of said 2nd substrate, and the lighting system arranged in the opposite side, Liquid crystal equipment characterized by having the driving means which drives said 1st and 2nd electrodes so that the liquid crystal driver voltage impressed to said liquid crystal layer through said 1st and 2nd electrodes in the time of lighting of this lighting system and an astigmatism LGT may be different from each other to the same image.

[Claim 2] The 1st and 2nd substrates of a transparent pair, and the liquid crystal layer pinched between these 1st and 2nd substrates, The 1st transparent electrode formed in the field by the side of said liquid crystal layer of said 1st substrate, and the transfective reflection layer formed in the field by the side of said liquid crystal layer of said 2nd substrate, The 2nd transparent electrode formed between this transfective reflection layer and said liquid crystal layer, Said liquid crystal layer of said 2nd substrate, and the lighting system arranged in the opposite side, Liquid crystal equipment characterized by having the driving

means which drives said 1st and 2nd electrodes, so that the liquid crystal driver voltage impressed to said liquid crystal layer through said 1st and 2nd electrodes in the time of lighting of this lighting system and an astigmatism LGT may be different from each other to the same image.

[Claim 3] Said transfective reflection layer is liquid crystal equipment according to claim 1 or 2 characterized by consisting of reflective film with which opening which can penetrate the light from said lighting system was prepared in each pixel.

[Claim 4] Said driving means is liquid-crystal equipment given in any 1 term of claims 1-3 characterized by to have the 1st control means which controls said 1st supply means to switch the electrical potential difference which a 1st supply means supply an electrical potential difference to said 1st electrode, and this 1st supply means supply to a setup for a reflective mold display according to said astigmatism LGT, and to switch to a setup for a transparency mold display according to said lighting.

[Claim 5] It is liquid crystal equipment according to claim 4 which is further equipped with the lighting means for switching which switches said lighting in said lighting system, and said astigmatism LGT, and is characterized by said 1st control means switching the electrical potential difference which said 1st supply means supplies to a setup for a reflective mold display, or a setup for a transparency mold display synchronizing with the switch actuation by this lighting means for switching.

[Claim 6] Said driving means is liquid-crystal equipment given in any 1 term of claims 1-5 characterized by to have the 2nd control means which controls said 2nd supply means to switch the electrical potential difference which a 2nd supply means supply an electrical potential difference to said 2nd electrode, and this 2nd supply means supply to a setup for a reflective mold display according to said astigmatism LGT, and to switch to a setup for a transparency mold display according to said lighting.

[Claim 7] Said 2nd supply means supplies the electrical potential difference

which has the actual value of the magnitude according to the gradation level which gradation data show to said 2nd electrode. Said 2nd control means Liquid crystal equipment according to claim 6 characterized by controlling said 2nd supply means to switch a setup of each magnitude of said actual value over each gradation level to a setup for a reflective mold display according to said astigmatism LGT, and to switch it to a setup for a transparency mold display according to said lighting.

[Claim 8] Liquid crystal equipment given in any 1 term of claims 1-7 characterized by having a color filter further between said transfective reflection layer and said 1st substrate.

[Claim 9] Liquid crystal equipment given in any 1 term of claims 1-8 characterized by said transfective reflection layer having irregularity.

[Claim 10] Electronic equipment characterized by equipping any 1 term of claims 1-9 with the liquid crystal equipment of a publication.

[Translation done.]

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention belongs to the technical field of liquid crystal equipment, and belongs to the technical field of the liquid crystal equipment which can switch and display a reflective mold display and a transparency mold display especially, and the electronic equipment using this liquid crystal equipment.

[0002]

[Description of the Prior Art] Conventionally, since high-reflective-liquid-crystal equipment had small power consumption, it was used abundantly at the pocket device, the adjunctive display of equipment, etc., but since the check by looking of a display was enabled using outdoor daylight, there was a trouble that a display could not be read in a dark location. For this reason, although outdoor daylight is used like usual high-reflective-liquid-crystal equipment in a bright location, the liquid crystal equipment of the format which enabled the check by looking of a display according to the internal light source is proposed in the dark location. This is carrying out the configuration which carried out sequential arrangement of a polarizing plate, a transflective reflecting plate, and the back light to the external surface of a liquid crystal panel observation-side and the opposite side as indicated by JP,57-049271,A, JP,57-049271,A, JP,57-049271,A, etc. With this liquid crystal equipment, if a reflective mold display is performed using the light which took in outdoor daylight and was reflected with the transflective reflecting plate and a perimeter becomes dark in being bright in a perimeter, the transparency mold display which enabled the check by looking of a display by the light which the back light was turned [light] on and made the transflective reflecting plate penetrate will be performed.

[0003] There are some which were indicated as another liquid crystal equipment by JP,8-292413,A which raised the brightness of a reflective mold display. This liquid crystal equipment is carrying out the configuration which carried out sequential arrangement of a transflective reflecting plate, a polarizing plate, and the back light to the external surface of a liquid crystal panel observation-side and the opposite side. If a reflective mold display is performed using the light

which took in outdoor daylight and was reflected with the transfective reflecting plate and a perimeter becomes dark in being bright in a perimeter, the transparency mold display which enabled the check by looking of a display by the light which the back light was turned [light] on and made the polarizing plate and the transfective reflecting plate penetrate will be performed. Since there is no polarizing plate between a liquid crystal cell and a transfective reflecting plate when it is made such a configuration, a reflective mold display brighter than the liquid crystal equipment mentioned above is obtained.

[0004]

[Problem(s) to be Solved by the Invention] However, with the liquid crystal equipment indicated by above-mentioned JP,8-292413,A, since a transparence substrate intervenes between a liquid crystal layer and a transfective reflecting plate, there is a trouble that duplex projection, a blot of a display, etc. will occur.

[0005] Furthermore, also in a device which colorization of a liquid crystal display is required with development of a pocket device in recent years and OA equipment, and uses high-reflective-liquid-crystal equipment, colorization is required in many cases. However, by the approach which combined the liquid crystal equipment indicated by the above-mentioned official report and a color filter, since the transfective reflecting plate is arranged behind a liquid crystal panel, the thick transparence substrate of a liquid crystal panel intervenes between a liquid crystal layer, a color filter, and a transfective reflecting plate, duplex projection, a blot of a display, etc. occur with parallax, and there is a trouble that sufficient coloring cannot be obtained.

[0006] In order to solve this problem, in JP,9-258219,A, the reflective mold electrochromatic display equipment which arranges a reflecting plate so that a liquid crystal layer may be touched is proposed. However, with this liquid crystal equipment, if a perimeter becomes dark, a display cannot be recognized.

[0007] On the other hand, in JP,7-318929,A, the liquid crystal equipment of the transfective reflective mold which prepared the pixel electrode which serves as the transfective reflective film to the inside of a liquid crystal cell is proposed.

However, with this liquid crystal equipment, a liquid crystal drive is performed using the same driving gear (for example, so-called X driver circuit and so-called Y driver circuit) also at the time of the time of a reflective mold display, and a transparency mold display, and the driver voltage corresponding to the same image data is fixed also at the time of a reflective mold display or a transparency mold display. However, according to research of invention-in-this-application persons, generally it sets to the liquid crystal equipment of this kind of transfective reflective mold, and the property of a reflection factor over the liquid crystal driver voltage at the time of a reflective mold display and the property of permeability over the liquid crystal driver voltage at the time of a transparency mold display are not in agreement. Consequently, with liquid crystal equipments, such as JP,7-318929,A, if liquid crystal driver voltage to the gradation of image data is set up so that good contrast and display concentration may be obtained in a driving gear at the time of a reflective mold display, at the time of a transparency mold display, neither good contrast nor display concentration will be obtained. On the contrary, when liquid crystal driver voltage to the gradation of image data is set up so that good contrast and display concentration may be obtained in a driving gear at the time of a transparency mold display, at the time of a reflective mold display, good contrast and display concentration have shortly the trouble of not being obtained.

[0008] This invention is made in view of an above-mentioned trouble, and neither the duplex projection by parallax, nor a blot of a display, etc. do not occur in the liquid-crystal equipment which can switch a reflective mold display and a transparency mold display, but let it be a technical problem to offer the electronic equipment which used the liquid-crystal equipment and its liquid-crystal equipment of the transfective reflective mold in which image display high-definition by high contrast is possible also at the time of a transparency mold display also at the time of a reflective mold display.

[0009]

[Means for Solving the Problem] The 1st and 2nd substrates of a pair transparent

in order that the 1st liquid crystal equipment of this invention may solve the above-mentioned technical problem, The 1st transparent electrode formed in the field by the side of the liquid crystal layer pinched between these 1st and 2nd substrates, and said liquid crystal layer of said 1st substrate, The 2nd electrode which consists of a transfective reflection layer formed in the field by the side of said liquid crystal layer of said 2nd substrate, Said liquid crystal layer of said 2nd substrate, and the lighting system arranged in the opposite side, It is characterized by having the driving means which drives said 1st and 2nd electrodes so that the liquid crystal driver voltage impressed to said liquid crystal layer through said 1st and 2nd electrodes in the time of lighting of this lighting system and an astigmatism LGT may be different from each other to the same image.

[0010] According to the 1st liquid crystal equipment of this invention, at the time of a reflective mold display, a transfective reflection layer (the 2nd electrode) reflects in a liquid crystal layer side the outdoor daylight which carried out incidence from the 1st substrate side. Under the present circumstances, since the transfective reflection layer (the 2nd electrode) is arranged at the liquid crystal layer side of the 2nd substrate, the duplex projection of a display or the blot of a display which there is almost no gap between a liquid crystal layer and a transfective reflection layer (the 2nd electrode), therefore originate in parallax do not generate it. On the other hand, the light source light which it was emitted from the lighting system and carried out incidence from the 2nd substrate side at the time of a transparency mold display is penetrated to a liquid crystal layer side through a transfective reflection layer (the 2nd electrode). Therefore, in a dark place, a bright display is attained using light source light.

[0011] Especially, by the driving means, in the time of lighting of a lighting system, and an astigmatism LGT, the 1st and 2nd electrodes drive so that the liquid crystal driver voltage impressed to a liquid crystal layer through the 1st and 2nd electrodes may be different from each other to the same image. Namely, since the property of a reflection factor over the liquid crystal driver voltage at the time

of a reflective mold display and the property of permeability over the liquid crystal driver voltage at the time of a transparency mold display generally are not in agreement with the liquid crystal equipment of a transflective reflective mold, Driving liquid crystal by the driver voltage which suited the reflection factor property over the driver voltage in the reflective mold display concerned at the time of the reflective mold display which carried out the astigmatism LGT of the lighting system by closing liquid crystal driver voltage like this invention if it is difference It becomes possible to drive liquid crystal by the driver voltage which suited the permeability property over the driver voltage in the transparency mold display concerned at the time of the transparency mold display which turned on the lighting system. Especially the thing for which the level of the liquid crystal applied voltage for giving a halftone indication of a white display and a black display is changed by a reflective mold display and transparency mold display is very useful.

[0012] The 1st and 2nd substrates of a pair transparent in order that the 2nd liquid crystal equipment of this invention may solve the above-mentioned technical problem, The 1st transparent electrode formed in the field by the side of the liquid crystal layer pinched between these 1st and 2nd substrates, and said liquid crystal layer of said 1st substrate, The 2nd transparent electrode formed between the transflective reflection layer formed in the field by the side of said liquid crystal layer of said 2nd substrate, and this transflective reflection layer and said liquid crystal layer, Said liquid crystal layer of said 2nd substrate, and the lighting system arranged in the opposite side, It is characterized by having the driving means which drives said 1st and 2nd electrodes so that the liquid crystal driver voltage impressed to said liquid crystal layer through said 1st and 2nd electrodes in the time of lighting of this lighting system and an astigmatism LGT may be different from each other to the same image.

[0013] According to the 2nd liquid crystal equipment of this invention, at the time of a reflective mold display, a transflective reflection layer reflects in a liquid crystal layer side the outdoor daylight which carried out incidence from the 1st

substrate side. Under the present circumstances, since the transfective reflection layer is arranged at the liquid crystal layer side of the 2nd substrate, the duplex projection of a display or the blot of a display which there is almost no gap between a liquid crystal layer and a transfective reflection layer, therefore originate in parallax do not generate it. On the other hand, the light source light which it was emitted from the lighting system and carried out incidence from the 2nd substrate side at the time of a transparency mold display is penetrated to a liquid crystal layer side through a transfective reflection layer. Therefore, in a dark place, a bright display is attained using light source light.

[0014] Especially, by the driving means, in the time of lighting of a lighting system, and an astigmatism LGT, the 1st and 2nd electrodes drive so that the liquid crystal driver voltage impressed to a liquid crystal layer through the 1st and 2nd electrodes may be different from each other to the same image. It becomes possible to drive liquid crystal by the driver voltage which suited the reflection factor property over the driver voltage in the transparency mold display concerned on the occasion of the transparency mold display which turned on the lighting system, driving liquid crystal by the driver voltage which suited the reflection factor property over the driver voltage in the reflective mold display concerned on the occasion of the reflective mold display which carried out the astigmatism LGT of the lighting system like the case of the 1st liquid-crystal equipment of this invention which this mentioned above.

[0015] In addition, as a drive method of the 1st and 2 liquid-crystal equipment, various drive methods with well-known passive matrix drive method, TFT (Thin Film Diode) active-matrix drive method, TFD (Thin Film Diode) active-matrix drive method, segment drive method, etc. are employable. Moreover, since it will drive as a display mode so that liquid crystal equipment may be in a dark condition at the time of un-driving if the former is adopted although NOMA reeve rack mode or any in no MARI White mode is sufficient, at the time of a transparency mold display, the optical leakage between the pixels which liquid crystal does not drive, or from between dots can be suppressed, and contrast can obtain a high

transparency mold display. Moreover, since the unnecessary reflected light can be stopped between pixels and from between dots to a display at the time of a reflective mold display, the display with high contrast can be obtained.

[0016] In the mode of 1 of the 1st of this invention, and the 2nd liquid crystal equipment, said transflective reflection layer consists of reflective film with which opening which can penetrate the light from said lighting system was prepared in each pixel, respectively.

[0017] Since the light from a lighting system can penetrate about each pixel through opening prepared in the transflective reflection layer according to this mode, the transparency mold display using a lighting system is attained.

Moreover, by the reflective film part which separated from opening, since outdoor daylight is reflected through liquid crystal, the reflective mold display using outdoor daylight is attained. In addition, or it was regularly arranged on the front face of for example, the reflective film as such opening, the rectangular slit and rectangular detailed opening with which it was dotted irregularly, a hole defect, a reentrant defect, etc. are sufficient. Or you may constitute so that two or more reflective film may be formed the shape of a stripe, and in the shape of an island and light may penetrate by using as opening the gap of the reflective film which adjoins each other. Moreover, as an ingredient of the reflective film, if it is the metal which aluminum (aluminum) can make reflect the outdoor daylight of light fields, such as Cr (chromium) and Ag (silver), although the metal of a principal component is used, especially the ingredient will not be limited. For example, if the reflective film is constituted including 95% of the weight or more of aluminum so that thickness may be 10nm or more 40nm or less, permeability is 40% or less more than per %, and the reflector of the transflective reflective mold whose reflection factor is 95% or less 50% or more can be produced.

[0018] On the other hand, as for the path of opening, it is desirable that it is [0.01 micrometer or more] 20 micrometers or less. By doing in this way, it is difficult for human being to recognize, and a reflective mold display and a transparency mold display are realizable for coincidence, suppressing degradation of the display

quality produced by having prepared opening. Moreover, as for opening, it is desirable to form by 30% or less of surface ratio 5% or more to the reflective film. A transparency mold display is realizable with the light from which suppressing the fall of the brightness of a reflective mold display is introduced into a liquid crystal layer through opening of the reflective film with **** by doing in this way. Such opening is easily producible at the photograph process / development process / exfoliation process of having used the resist.

[0019] Especially, since it has both the function in which the transfective reflection layer (the 2nd electrode) which consists of such reflective film reflects outdoor daylight in the case of the 1st liquid crystal equipment of this invention, and the function to impress an electrical potential difference to liquid crystal, as compared with the case where the reflective film and a pixel electrode are formed separately, the manufacture or design top of an equipment configuration top is also advantageous, and low cost-ization can be attained. On the other hand, in the case of the 1st liquid crystal equipment of this invention, since it is not necessary to prepare opening in the 2nd transparent electrode, the equipment dependability about the 2nd electrode concerned and the manufacture yield increase.

[0020] In other modes of the 1st of this invention, and the 2nd liquid crystal equipment, said driving means is equipped with the 1st control means which controls said 1st supply means to switch the electrical potential difference which a 1st supply means to supply an electrical potential difference to said 1st electrode, and this 1st supply means supply to a setup for a reflective mold display according to said astigmatism LGT, and to switch to a setup for a transparency mold display according to said lighting, respectively.

[0021] According to this mode, an electrical potential difference is supplied to the 1st electrode (for example, scanning line) by the 1st supply means (for example, Y driver circuit), but under control by the 1st control means, according to the astigmatism LGT of a lighting system, this electrical potential difference supplied is switched to a setup for a reflective mold display, and is switched to a setup for

a transparency mold display according to lighting of a lighting system on the other hand. Therefore, liquid crystal can be driven by the driver voltage which suited the reflection factor property and permeability property over driver voltage, respectively at the time of a reflective mold display and a transparency mold display.

[0022] It has further the lighting means for switching which switches said lighting in said lighting system, and said astigmatism LGT, and synchronizing with the switch actuation by this lighting means for switching, said 1st control means may consist of this mode so that the electrical potential difference which said 1st supply means supplies may be switched to a setup for a reflective mold display, or a setup for a transparency mold display.

[0023] In other modes of the 1st of this invention, and the 2nd liquid crystal equipment, said driving means is equipped with the 2nd control means which controls said 2nd supply means to switch the electrical potential difference which a 2nd supply means to supply an electrical potential difference to said 2nd electrode, and this 2nd supply means supply to a setup for a reflective mold display according to said astigmatism LGT, and to switch to a setup for a transparency mold display according to said lighting, respectively.

[0024] According to this mode, an electrical potential difference is supplied to the 1st electrode (for example, data line) by the 2nd supply means (for example, X driver circuit), but under control by the 1st control means, according to the astigmatism LGT of a lighting system, this electrical potential difference supplied is switched to a setup for a reflective mold display, and is switched to a setup for a transparency mold display according to lighting of a lighting system on the other hand. Therefore, liquid crystal can be driven by the driver voltage which suited the reflection factor property and permeability property over driver voltage, respectively at the time of a reflective mold display and a transparency mold display.

[0025] By this mode, said 2nd supply means may control said 2nd supply means to supply the electrical potential difference which has the actual value of the

magnitude according to the gradation level which gradation data show to said 2nd electrode, and for said 2nd control means to switch a setup of each magnitude of said actual value over each gradation level to a setup for a reflective mold display according to said astigmatism LGT, and to switch to a setup for a transparency mold display according to said lighting.

[0026] Thus, if constituted, under control by the 2nd control means, a setup of each magnitude of the actual value over each gradation level will be switched to a setup for a reflective mold display according to an astigmatism LGT, and will be switched to a setup for a transparency mold display according to lighting of an another side lighting system. And the electrical potential difference which has the actual value of the magnitude according to the gradation level which gradation data show with the 2nd supply means is supplied to said 2nd electrode.

Therefore, it crosses especially throughout gradation and liquid crystal can be driven by good driver voltage.

[0027] In other modes of the 1st of this invention, and the 2nd liquid crystal equipment, it has a color filter further between said transflective reflection layer and said 1st substrate, respectively.

[0028] According to this mode, reflective mold color display by outdoor daylight and transparency mold color display using a lighting system can be performed. As for a color filter, it is desirable to have 25% or more of permeability to all the light of the 380nm or more wavelength range of 780nm or less. By doing in this way, bright reflective mold color display and transparency mold color display are realizable.

[0029] In other modes of the 1st of this invention, and the 2nd liquid crystal equipment, said transflective reflection layer has irregularity, respectively.

[0030] According to this mode, therefore the feeling of a mirror plane of a reflector can be lost unevenly, and it can be shown as the diffusing surface (white side). Moreover, the display of a wide-field-of-view angle is attained by dispersion by irregularity. The shape of this toothing can be formed by forming or damaging the glass substrate of a substrate itself by fluoric acid using photosensitive acrylic

resin etc., on the substrate of a reflector. In addition, it is desirable to form the transparent flattening film further on the concavo-convex front face of a reflector, and to carry out flattening of the front face (front face which forms the orientation film) facing a liquid crystal layer from a viewpoint which prevents the poor orientation of liquid crystal.

[0031] It is characterized by equipping the electronic equipment of this invention with the liquid crystal equipment of this invention mentioned above, in order to solve the above-mentioned technical problem.

[0032] According to the electronic equipment of this invention, there is no blot of the duplex projection and display by parallax, and various kinds of electronic equipment using transfective high-reflective-liquid-crystal equipment and transfective reflective mold electrochromatic display equipment which can switch and display a reflective mold display and a transparency mold display can be realized. Such electronic equipment can realize a display high-definition by related especially high contrast to surrounding outdoor daylight also in a location dark also in a bright location.

[0033]

[Embodiment of the Invention] Hereafter, the gestalt of operation of this invention is explained with reference to a drawing.

[0034] (The 1st operation gestalt) The 1st operation gestalt of the liquid crystal equipment concerning this invention is explained with reference to drawing 7 from drawing 1. Drawing 1 (a) is outline drawing of longitudinal section showing the structure of the 1st operation gestalt of this invention. Drawing 1 (b) It is the outline top view of the 1st operation gestalt shown in drawing 1 (a), and drawing 2 - drawing 6 are the expansion top views showing various kinds of examples of opening prepared in the reflector in the 1st operation gestalt, respectively.

Drawing 7 It is the property Fig. showing the property of the reflection factor R at the time of the reflective mold display to the driver voltage in the liquid crystal equipment of the 1st operation gestalt, and the property of the permeability T at the time of a transparency mold display. Although the color filter and black matrix

layer which were shown in drawing 1 (a) are omitted and it has shown only three every direction at a time also about the electrode of the shape of an expedient upper stripe of explanation by drawing 1 (b) in order to make electrode disposition legible, the electrode of the shape of many [far] numbers of a stripe prepares with actual liquid crystal equipment, and it is ****. In addition, although the 1st operation gestalt is fundamentally related with the liquid crystal display of a passive-matrix mold, it is possible to apply also to the equipment of a active-matrix mold, the equipment of other segmental dies, and other liquid crystal equipments by the same configuration.

[0035] As shown in drawing 1 (a) and drawing 1 (b), with the 1st operation gestalt, the liquid crystal cell to which the closure of the liquid crystal layer 3 was carried out by the frame-like sealant 4 is formed between two transparence substrates 1 and 2. The liquid crystal layer 3 consists of nematic liquid crystals with a predetermined twist angle. A color filter 5 is formed on the inside of the front transparence substrate 1, and the coloring layer of three colors of R (red), G (green), and B (blue) is arranged by this color filter 5 by the predetermined pattern. The transparent protective coat 10 is covered on the front face of a color filter 5, and the transparent electrode 6 of the shape of two or more stripe is formed with the ITO (Indium TinOxide) film etc. on the front face of a protective coat 10. The orientation film 9 is formed on the front face of a transparent electrode 6, and rubbing processing is performed in the predetermined direction.

[0036] On the other hand, on the inside of the back transparence substrate 2, two or more arrays are carried out so that the reflector 7 of the shape of a stripe formed for every coloring layer of the above-mentioned color filter 5 may intersect the above-mentioned transparent electrode 6. When it is equipment of the active-matrix mold equipped with the TFD component or the TFT component, each reflector 7 is formed in the shape of a rectangle, and is connected to wiring through an active component. This reflector 7 is formed of Cr, aluminum, etc., and that front face is the reflector in which the light which carries out incidence is reflected from the transparence substrate 1 side. On the front face of a reflector 7,

the same orientation film 19 as the above is formed. Much opening 7b (refer to drawing 1 (b)) of the diameter of 2 micrometer is prepared in the reflector 7, and the gross area of opening 7b is prepared in it at about 10% of a rate to the gross area of a reflector 7.

[0037] With reference to drawing 2 - drawing 6 , various kinds of examples of a reflector 7 and opening 7b are explained here.

[0038] As first shown in drawing 2 , the transparent electrode 802 (it corresponds to the transparent electrode 6 of drawing 1) of the shape of a stripe formed in the upper transparence substrate is countered, and the rectangular slit 803 (it corresponds to opening 7b of drawing 1) may be formed in the reflector 802 (it corresponds to the reflector 7 of drawing 1) of the shape of a stripe formed on the lower transparence substrate. In addition, a square, a rectangle, or other polygons and round shapes are sufficient as the rectangular slit 803.

Furthermore, also about arrangement or direction, as long as at least one opening is prepared in each dot (namely, field where a transparent electrode 801 and a reflector 802 cross among drawing 2), it may be arranged regularly and may be dotted irregularly.

[0039] the hole with which the reflector 602 (it corresponds to the reflector 7 of drawing 1) of the shape of a stripe which countered the transparent electrode 601 (it corresponds to the transparent electrode 6 of drawing 1) of the shape of a stripe formed in the upper transparence substrate, and was formed on the lower transparence substrate as shown in drawing 3 is dotted irregularly -- the detailed defective parts 603 (it corresponds to opening 7b of drawing 1), such as a defect and a reentrant defect, may be formed.

[0040] As shown in drawing 4 , the transparent electrode 301 (it corresponds to the transparent electrode 6 of drawing 1) of the shape of a stripe formed in the upper transparence substrate is countered, the predetermined gap 303 (it corresponds to opening 7b of drawing 1) may be separated, and the reflector 303 (it corresponds to the reflector 7 of drawing 1) of the shape of a stripe formed on the lower transparence substrate may be arranged. That is, the light

from a back light 15 is introduced into the liquid crystal layer 3 through this gap 303.

[0041] Although the 1st operation gestalt starts simple (passive) matrix mold liquid crystal equipment here for example, in the case of the liquid crystal equipment of the transfective reflective mold of the TFD active-matrix drive method mentioned later From the same view as the example of drawing 4 , as shown in drawing 5 , the transparent electrode 201 (it corresponds to the transparent electrode 6 of drawing 1) of the shape of a stripe formed in the upper transparence substrate is countered. The predetermined gap 205 (it corresponds to opening 7b of drawing 1) may be separated, and the reflector 204 (it corresponds to the reflector 7 of drawing 1) of the shape of an island formed for every dot on the lower transparence substrate may be arranged. That is, the light from a back light 15 is introduced into the liquid crystal layer 3 through this gap 205. In addition, in this case, the scanning line 202 is formed on a bottom transparence substrate, the TFD component 203 is further formed corresponding to each dot, and the scanning line 202 and a reflector 204 are connected through the TFD component 203.

[0042] furthermore, in the case of the liquid crystal equipment of the transfective reflective mold of the TFT active-matrix drive method mentioned later, for example From the same view as the example of drawing 4 , as shown in drawing 6 , the transparent electrode 1401 (it corresponds to the transparent electrode 6 of drawing 1 R> 1) formed in the upper transparence substrate is countered. The predetermined gap 1406 (it corresponds to opening 7b of drawing 1) may be separated, and the reflector 1405 (it corresponds to the reflector 7 of drawing 1 R> 1) of the shape of an island formed for every dot on the lower transparence substrate may be arranged. That is, the light from a back light 15 is introduced into the liquid crystal layer 3 through this gap 1406. In addition, in this case, on a bottom transparence substrate, the data line 1402 and the scanning line 1403 are formed, the TFT component 1404 is further formed corresponding to each dot, and the data line 1402 and the scanning line 1403, and a reflector 1405 are

connected through the TFT component 1404.

[0043] As again shown in drawing 1 (a) and drawing 1 (b), a polarizing plate 11 is arranged on the external surface of the front transparency substrate 1, and the phase contrast plate 13 is arranged between the polarizing plate 11 and the transparent electrode 1. Moreover, behind the liquid crystal cell, the phase contrast plate 14 is arranged behind the transparency substrate 2, and the polarizing plate 12 is arranged behind this phase contrast plate 14. And behind the polarizing plate 12, the back light 15 which has fluorescence tubing 15a which emits the white light, and light guide plate 15b equipped with the incidence end face in alignment with this fluorescence tubing 15a is arranged. Light guide plate 15b is the transparent bodies, such as an acrylic resin plate with which the split face for dispersion was formed in the whole rear face, or the printing layer for dispersion was formed, and it is constituted so that an almost uniform light may be emitted from the top face of drawing in response to the light of fluorescence tubing 15a which is the light source in an end face. As other back lights, LED (light emitting diode), EL (electroluminescence), etc. can be used.

[0044] With the 1st operation gestalt, in order to prevent light leaking from field 7a between each reflector 7 at the time of a transparency mold display, superficially, black matrix layer 5a which is the protection-from-light section formed between each coloring layer of a color filter 5 corresponds mostly, and is prepared. Black matrix layer 5a puts Cr layer, or forms it by photosensitive black resin.

[0045] Next, actuation of the 1st operation gestalt constituted as mentioned above is explained.

[0046] First, a reflective mold display is explained. The polarizing plate 11 in drawing 1, the phase contrast plate 13, and a color filter 5 are penetrated, respectively, it is reflected by the reflector 7 after passing the liquid crystal layer 3, and outgoing radiation of the outdoor daylight is again carried out from a polarizing plate 11. At this time, those middle brightness is controlled according to the applied voltage to the liquid crystal layer 3 in transparency (bright state)

and absorption (dark condition) list of a polarizing plate 11.

[0047] Next, a transparency mold display is explained. With a polarizing plate 12 and the phase contrast plate 14, the light from a back light 15 turns into predetermined polarization, is introduced into the liquid crystal layer 3 from opening 7b of a reflector 7, and penetrates a color filter 5 and the phase contrast plate 13 after passing the liquid crystal layer 3, respectively. At this time, those middle brightness is controlled according to the applied voltage to the liquid crystal layer 3 in transparency (bright state) and absorption (dark condition) list of a polarizing plate 11.

[0048] Here, as shown in drawing 7, generally in the liquid crystal equipment of the transfective reflective mold like the 1st operation gestalt, it has become clear that the property of the reflection factor R at the time of the reflective mold display to driver voltage and the property of the permeability T at the time of a transparency mold display are so-called difference as a result of the research and the experiment by invention-in-this-application persons. That is, if it is going to drive the liquid crystal equipment of this kind of transfective reflective mold by fixed driver voltage to the same image, without being temporarily based on lighting and the astigmatism LGT of a back light 15, in order to perform the Takashina tone display only about either at the time of a reflective mold display and a transparency mold display, or in order to raise contrast, the most of the slope of the **** characteristic curve shown in drawing 7 can be made. However, with this operation gestalt, in the time of lighting of a back light 15, and an astigmatism LGT, a transparent electrode 6 and a reflector 7 drive so that the liquid crystal driver voltage impressed to the liquid crystal layer 3 through a transparent electrode 6 and a reflector 7 may be different from each other to the same image. That is, with this operation gestalt, the liquid crystal layer 3 drives by the driver voltage which suited the property of the reflection factor R as shown in drawing 7 at the time of the reflective mold display which carried out the astigmatism LGT of the back light 15, and liquid crystal drives by the driver voltage which suited the property of the permeability T as shown in drawing 7 at

the time of the transparency mold display which turned on the back light 15. Especially the thing for which the level of the liquid crystal applied voltage for giving a halftone indication of a white display and a black display is changed by a reflective mold display and transparency mold display is very useful. A setup of the driver voltage which suits a setup of the driver voltage which suits the property of these reflection factors R, and the property of permeability T is performed comparatively easily by searching for beforehand the property of the reflection factor R for every driver voltage, and the property of permeability T experimentally, experientially, and theoretically about each liquid crystal equipment, respectively. In addition, the concrete configuration of the driving gear which performs such a drive is explained in full detail as the 3rd operation gestalt.

[0049] According to this operation gestalt mentioned above, a reflective mold display and a transparency mold display without duplex projection or a blot of a display can be switched and displayed, and electrochromatic display equipment high-definition by high contrast can be especially realized also in any of a reflective mold display and a transparency mold display.

[0050] In addition, according to the 1st operation gestalt, also in any of a reflective mold display and a transparency mold display, a good display control is made with polarizing plates 11 and 12. And while reducing the effect of the color tones on coloring which originates in the wavelength dispersion of the light at the time of a reflective mold display with the phase contrast plate 13, it becomes possible to reduce the effect of the color tones on coloring which originates in the wavelength dispersion of the light at the time of a transparency mold display with the phase contrast plate 14. Moreover, about the phase contrast plates 13 and 14, it is also possible to arrange about two or more phase differential plates in each location according to coloring compensation of a liquid crystal cell or viewing-angle compensation.

[0051] Furthermore, it is not flat in a reflector 7, for example, you may constitute from this operation gestalt mentioned above so that it may have the irregularity

whose difference of elevation is about 0.8 micrometers. Thus, if constituted, therefore the feeling of a mirror plane of a reflector 17 can be lost unevenly, it can be shown as the diffusing surface (white side), and the display of a wide-field-of-view angle will be attained by dispersion by irregularity. On the other hand, the optical diffusion plate of the transparency mold which consists of a thing of an internal diffusion form which distributed the transparent particle from which a refractive index differs in transparency bases, such as acrylic resin, between the phase contrast plate 13 and the transparency substrate 1, and a thing of the surface diffusion form which carried out surface roughening (mat-izing) of the front-face top of a transparency base may be arranged. Thus, if constituted, reflected [the outdoor daylight by direct reflection of a reflector 7] can be prevented, and visibility can be raised. Furthermore, in case much detailed pores may be formed using vacuum evaporation, sputtering, a photolithography process, etc., an indication is given bright in case this performs a transparency mold display, and a reflective mold display is performed to a reflector 7, it can prevent reflected [outdoor daylight].

[0052] (The 2nd operation gestalt) The 2nd operation gestalt of the liquid crystal equipment concerning this invention is explained with reference to drawing 8 and drawing 9 . Drawing 8 is outline drawing of longitudinal section showing the structure of the 2nd operation gestalt of this invention, drawing 9 (a) is the expansion top view showing an example of the reflector concerning the 2nd operation gestalt, and drawing 9 (b) is the expansion top view showing other examples of this reflector. The reference mark same about the same component as the 1st operation gestalt shown in drawing 1 is attached among drawing 8 , and the explanation is omitted. In addition, although this operation gestalt is fundamentally related with the liquid crystal display of a passive-matrix mold, it is possible to apply also to the equipment of a active-matrix mold, the equipment of other segmental dies, and other liquid crystal equipments by the same configuration.

[0053] As shown in drawing 8 , with the 2nd operation gestalt, it is not the

reflector of a monolayer with which the 2nd electrode on a bottom substrate has opening compared with the 1st operation gestalt. Consist of a transparent electrode prepared on the transfective reflecting plate which has opening. (That is, the 1st electrode achieves only an electrode function and the reflective film prepared separately achieves a transfective reflex function) Points differ and it mainly differs further in that the color filter and the black matrix layer are prepared on the bottom substrate. About other configurations, it is the same as that of the case of the 1st operation gestalt fundamentally.

[0054] Namely, as shown in drawing 8 , in the transparence substrate 1 side, rubbing processing is performed to the orientation film 19 in the predetermined direction, and the liquid crystal molecule has the pre tilt angle of about 85 degrees in the direction of rubbing. When it is equipment of the active-matrix mold equipped with the TFD component or the TFT component, a transparent electrode 6 is formed in the shape of a rectangle, and is connected to wiring through an active component.

[0055] On the other hand, on the inside of the lower transparence substrate 2, the irregularity of about 0.8 micrometers of quantity lowness is formed with photosensitive acrylic resin, on the front face, the spatter of the aluminum which added 1.0% of the weight of Nd is carried out by the thickness of 25nm, and the transfective reflecting plate 411 is formed. On the transfective reflecting plate 411, a color filter 414 is formed through a protective coat 412, and the coloring layer of three colors of R (red), G (green), and B (blue) is arranged by this color filter 414 by the predetermined pattern. The transparent protective coat is covered on the front face of a color filter 414, and the transparent electrode 416 of the shape of two or more stripe is formed of ITO etc. on the front face of this protective coat. Two or more arrays are carried out so that the transparent electrode 416 of the shape of a stripe formed for every coloring layer of a color filter 414 may intersect the above-mentioned transparent electrode 6. On the front face of a transparent electrode 416, the same orientation film 19 as the above is formed. In addition, rubbing processing is not performed to this

orientation film 19. As phase contrast plates 13 and 14, especially a quarter-wave length plate is used, respectively.

[0056] Furthermore with the 2nd operation gestalt, the transparency shafts P1 and P2 of a polarizing plate 11 and a polarizing plate 12 are set up in this direction. The direction of the lagging axes C1 and C2 of the phase contrast plates (namely, quarter-wave length plate) 13 and 14 is set up in the direction rotated clockwise $\theta = 45$ degrees to the transparency shafts P1 and P2 of these polarizing plates 11 and 12, respectively. Furthermore, the direction R1 of rubbing processing of the orientation film 9 on the inside of the transparency substrate 1 is also given in the direction of the lagging axes C1 and C2 of the phase contrast plates (namely, quarter-wave length plate) 13 and 14, and the direction in agreement. This direction R1 of rubbing specifies the falling direction of [at the time of electric-field impression of the liquid crystal layer 3]. A dielectric anisotropy uses a negative pneumatic liquid crystal for the liquid crystal layer 3.

[0057] Furthermore, with the 2nd operation gestalt, in order to prevent light leaking from the field between each dot at the time of a transparency mold display, superficially, the black matrix layer 413 which is the protection-from-light section formed between each coloring layer of a color filter 414 corresponds mostly, and is prepared. The black matrix layer 413 puts Cr layer, or forms it by photosensitive black resin.

[0058] The same inclination as the case of the 1st operation gestalt indicated to be the property of the reflection factor R at the time of the reflective mold display to the driver voltage in the liquid crystal equipment of the 2nd operation gestalt constituted as mentioned above and the property of the permeability T at the time of a transparency mold display to drawing 7 is shown. In addition, in case the liquid crystal equipment of the 2nd operation gestalt is driven, the display condition at the time of no electric-field impressing is dark (black). If it drives in NOMA reeve rack mode, since the optical leakage and the unnecessary reflected light from the gap of the transparent electrode 416 which liquid crystal does not

drive can be stopped, it becomes unnecessary thus, to form the black matrix layer 413.

[0059] Next, actuation of the 2nd operation gestalt constituted as mentioned above is explained.

[0060] First, a reflective mold display is explained. The polarizing plate 11 in drawing 8 and the phase contrast plate 13 are penetrated, respectively, and after passing the liquid crystal layer 3, a color filter 414 is passed, it is reflected by the transfective reflecting plate 411, and outgoing radiation of the outdoor daylight is again carried out from a polarizing plate 11. At this time, those middle brightness is controlled according to the applied voltage to the liquid crystal layer 3 in transparency (bright state) and absorption (dark condition) list of a polarizing plate 11.

[0061] Next, a transparency mold display is explained. With a polarizing plate 12 and the phase contrast plate 14, the light from a back light 15 turns into predetermined polarization (the circular polarization of light, elliptically polarized light, or linearly polarized light), is introduced into the liquid crystal layer 3 from the transfective reflecting plate 411, and penetrates the phase contrast plate 13 after passing the liquid crystal layer 3. At this time, transparency (bright state), absorption (dark condition), and its middle brightness of a polarizing plate 11 are controllable according to the applied voltage to the liquid crystal layer 3.

[0062] Here, like the case of the 1st operation gestalt, also in the 2nd operation gestalt, in the time of lighting of a back light 15, and an astigmatism LGT, a transparent electrode 6 and a transparent electrode 416 drive so that the liquid crystal driver voltage impressed to the liquid crystal layer 3 through a transparent electrode 6 and a transparent electrode 416 may be different from each other to the same image. That is, with this operation gestalt, the liquid crystal layer 3 drives by the driver voltage which suited the property of the reflection factor R as shown in drawing 7 at the time of the reflective mold display which carried out the astigmatism LGT of the back light 15, and liquid crystal drives by the driver voltage which suited the property of the permeability T as shown in drawing 7 at

the time of the transparency mold display which turned on the back light 15. In addition, the concrete configuration of the driving gear which performs such a drive is explained in full detail as the 3rd operation gestalt.

[0063] According to this operation gestalt mentioned above, a reflective mold display and a transparency mold display without duplex projection or a blot of a display can be switched and displayed, and electrochromatic display equipment high-definition by high contrast can be especially realized also in any of a reflective mold display and a transparency mold display.

[0064] Moreover, to the transfective reflecting plate 411 of the 2nd operation gestalt, aluminum covers this front face by the protective coat using the metal layer of a principal component, and the color filter layer, the protective coat, and the transparent electrode are formed on it. For this reason, since aluminum metal layer touches neither with a direct ITO developer nor a color filter developer, aluminum metal layer does not dissolve with a developer. Furthermore, aluminum metal layer which a blemish tends to attach can be made easy to deal with it. aluminum of 25nm thickness which added 1.0% of the weight of Nd shows the value of 80% of reflection factors, and 10% of permeability, and can check fully functioning as a transfective reflecting plate 411.

[0065] Moreover, since the transfective reflecting plate 411 which gave irregularity can reflect the reflected light in a wide angle, it can realize the liquid crystal equipment of a wide-field-of-view angle.

[0066] Here, the example about a transparent electrode 416 established the transfective reflecting plate 411 which has opening, and on this is explained with reference to drawing 9 .

[0067] First, by the 1st example, as shown in drawing 9 (a), transparent electrode 602' (it corresponds to the transparent electrode 6 of drawing 8) of the shape of a stripe formed in the upper transparence substrate from ITO etc. is countered. Two or more formation of reflecting plate 602' (it corresponds to the transfective reflecting plate 411 of drawing 8) of width of face W1 is carried out by the shape of a stripe from aluminum etc. on a lower transparence substrate. Furthermore,

two or more formation of transparent electrode 603' (it corresponds to the transparent electrode 416 of drawing 8) of the somewhat larger width of face W2 (namely, $W2 > W1$) than reflecting plate 602' is carried out by the shape of a stripe from ITO etc. Consequently, the part of the width of face of W1-W1 functions as opening on each reflecting plate 602' of every. That is, the transparency of the light from a back light 15 is attained in the field in which it sees superficially in this way, and reflecting plate 602' is not formed in, and the transparent electrode 416 is formed, and it becomes possible to perform a transparency mold display by this field. On the other hand, reflection of outdoor daylight is attained in the field in which it sees superficially in this way, and reflecting plate 602' is formed in, and the transparent electrode 416 is formed, transparency becomes possible, and it becomes possible to perform a reflective mold display by this field.

[0068] Next, by the 2nd example, as shown in drawing 9 (b), on the lower transparence substrate, two or more formation of the island-like reflecting plate 503 (it corresponds to the transflective reflecting plate 411 of drawing 8) is carried out from aluminum etc., and the somewhat larger thing transparent electrode 504 (it corresponds to the transparent electrode 416 of drawing 8) than a reflecting plate 503 is further formed according to the shape of an island from ITO etc. Consequently, the part of that perimeter functions as opening every reflecting plate 503. That is, the transparency of the light from a back light 15 is attained in the field in which it sees superficially in this way, and a reflecting plate 503 is not formed in, and the transparent electrode 504 is formed, and it becomes possible to perform a transparency mold display by this field. On the other hand, reflection of outdoor daylight is attained in the field in which it sees superficially in this way, and the reflecting plate 503 is formed in, and the transparent electrode 504 is formed, transparency becomes possible, and it becomes possible to perform a reflective mold display by this field. In addition, this example is for TFD active ** matrix drive methods, and each transparent electrode 504 is connected to each scanning line 501 through the TFD component 502. The transflective reflecting plate and transparent electrode of

liquid crystal equipment of a TFT active-matrix drive method can be formed on a bottom transparency substrate almost like this modification.

[0069] By the example explained using drawing 9, respectively, since the light which carried out incidence in addition to the pixel electrode or the dot electrode is unrelated to a display and the contrast of a transparency mold display is only reduced, it is making the display mode of a light-shielding film (black matrix layer) or a liquid crystal layer into Nor Marie Black, and intercepting is desirable.

[0070] The Rhine width of face (L) of transparent electrode 601' which consists of ITO in the example of drawing 9 (a) 198 micrometers, the bottom -- a substrate -- an inside -- aluminum -- from -- becoming -- a reflecting layer -- 602 -- ' -- Rhine -- width of face (W1) -- 46 -- micrometer -- the -- a top -- having formed -- ITO -- from -- becoming -- a transparent electrode -- 603 -- ' -- Rhine -- width of face (W2) -- 56 -- micrometer -- ** -- carrying out -- if -- About 70% of the outdoor daylight introduced into the liquid crystal layer can be reflected, outgoing radiation can be carried out from a back light, and about 10% of the light introduced into the lower transparency substrate can be made to penetrate.

[0071] Moreover, since aluminum reflecting layer of this operation gestalt formed the ITO transparent electrode in the front face, a blemish can be made hard to attach to aluminum reflecting layer, and since two, aluminum reflecting layer and an ITO transparent electrode, become electrode Rhine, low resistance-ization of electrode Rhine of it is attained.

[0072] (The 3rd operation gestalt) Next, the 3rd operation gestalt concerning liquid crystal equipment including the drive circuit which drives the liquid crystal equipment of the 1st and 2nd operation gestalt of this invention mentioned above is explained with reference to the block diagram of drawing 10.

[0073] In drawing 10, liquid crystal equipment is equipped with the driving gear which drives the liquid crystal panel (it corresponds to the liquid crystal equipment in the 1st and 2nd operation gestalt mentioned above) 103 having a back light 15, the light source driving gear 108 which drives a back light 15, and the lighting switching unit 107 which switches lighting and the astigmatism LGT

of a back light 15, and is constituted.

[0074] Data-line drive control circuit 110a as an example of the 2nd control means which controls the driver voltage of the X driver circuit 110 as an example of the 2nd supply means which drives the data line with which especially the driving gear was wired by the liquid crystal panel 103, and the X driver circuit 110, It has scanning-line drive control circuit 100a as an example of the 1st control means which controls the scanning-line driver voltage in the Y driver circuit 100 and the Y driver circuit 100 as an example of the 1st supply means which drives the scanning line wired by the liquid crystal panel 103, and is constituted. Data-line drive control circuit 110a will output the data-line drive control signal S1 to the X driver circuit 110 based on these input signals, if a picture signal Sv and the display-control signal Ss are inputted from an external picture signal processing circuit. In response, the X driver circuit 110 drives each data line by supplying a picture signal to each data line to predetermined timing. Scanning-line drive control circuit 100a will output the scanning-line drive control signal S2 to the Y driver circuit 100 based on this input signal, if the display-control signal Ss is inputted from an external picture signal processing circuit. In response, the Y driver circuit 100 drives each scanning line by supplying a scan signal to each scanning line to predetermined timing.

[0075] A back light 15 and the light source driving gear 108 constitute an example of a lighting system. In response to the lighting change-over signal SL from the lighting switching unit 107, the light source driving gear 102 supplies the light source driver voltage VL to a back light 15 alternatively. In response, a back light 15 irradiates the liquid crystal layer in a liquid crystal panel 103 through a transfective reflection layer as mentioned above.

[0076] manual switch actuation the lighting switching unit 107 constitutes an example of a lighting means for switching, and according lighting and the astigmatism LGT of a back light 15 to an operator -- or the lighting change-over signal SL is outputted to the light source driving gear 108 by detecting outdoor daylight level. namely, manual actuation according to an operator in a bright

place -- or the lighting change-over signal SL of the purport to which the astigmatism LGT of the back light 15 is carried out automatically is outputted to the light source driving gear 108 by detection of outdoor daylight level, and the reflective mold display by outdoor daylight is performed, without turning on a back light 15. on the other hand, manual actuation according to an operator in a dark place -- or the lighting change-over signal SL of the purport which makes a back light 15 turn on automatically is outputted to the light source driving gear 108 by detection of outdoor daylight level, the light source driver voltage VL is supplied, a back light 15 is turned on, and a transparency mold display is performed.

[0077] The driving gear which becomes **** from the **** X driver circuit 110, data-line drive control circuit 110a, the Y driver circuit 100, and scanning-line drive control circuit 110a is with the time of lighting of a back light 15, and an astigmatism LGT, and it consists of especially this examples so that the liquid crystal driver voltage impressed to a liquid crystal layer through the scanning line and the data line may be different from each other to the same image based on the lighting change-over signal SL outputted from the lighting switching unit 107, and the scanning line and the data line may be driven.

[0078] More specifically data-line drive control circuit 110a If the lighting change-over signal SL outputted from the lighting switching unit 107 is inputted, it is based on the signal level. At the time of the astigmatism LGT of a back light 15 An electrical-potential-difference setup of the picture signal which the X driver circuit 110 supplies to the data line to the gradation level (or white and black level) specified by the picture signal Sv is switched to an electrical-potential-difference setup optimized for [which was set up beforehand] the reflective mold display based on the property of the reflection factor R like drawing 7 . It replaces with this, or in addition, scanning-line drive control circuit 100a will switch an electrical-potential-difference setup of the scan signal which the Y driver circuit 100 supplies to the scanning line based on the property of the reflection factor R like drawing 7 based on the signal level to an electrical-potential-difference setup

optimized for [which was set up beforehand] the reflective mold display at the time of the astigmatism LGT of a back light 15, if the lighting change-over signal SL outputted from the lighting switching unit 107 is inputted. Furthermore, data-line drive control circuit 110a is switched to an electrical-potential-difference setup optimized for [which was beforehand set up based on the property of the permeability T like drawing 7 in an electrical-potential-difference setup of the picture signal which the X driver circuit 110 supplies to the data line] the transparency mold display based on the lighting change-over signal SL outputted from the lighting switching unit 107 at the time of lighting of a back light 15. It replaces with this or, in addition, scanning-line drive control circuit 100a is switched to an electrical-potential-difference setup optimized for [which was beforehand set up based on the property of the permeability T like drawing 7 in an electrical-potential-difference setup of the scan signal which the Y driver circuit 100 supplies to the scanning line] the transparency mold display based on the lighting change-over signal SL outputted from the lighting switching unit 107 at the time of lighting of a back light 15. Since an electrical-potential-difference setup in the Y driver circuit 100 optimized an electrical-potential-difference setup in the X driver circuit 110 optimized for [these] the reflective mold display, an electrical-potential-difference setup in the Y driver circuit 100 optimized for the reflective mold display, an electrical-potential-difference setup in the X driver circuit 110 optimized for the transparency mold display, and for a transparency mold display is what becomes settled according to the class of liquid-crystal equipment, respectively, it is beforehand called for by experimental, theoretical, a simulation, etc. about each liquid-crystal equipment. And by electrical-potential-difference setup optimized, for example, the hardware design of the X driver circuit 110, data-line drive control circuit 110a, the Y driver circuit 100, and the scanning-line drive control circuit 110 is made so that an output of a picture signal and/or a scan signal may be possible, and a liquid crystal drive is performed by electrical-potential-difference setup optimized the object for a reflective mold display, or for the transparency mold display by simple switch

actuation in these circuits.

[0079] As explained above, according to the 3rd operation gestalt, generally in the liquid crystal equipment of a transfective reflective mold, the property of the reflection factor R at the time of the reflective mold display to driver voltage, and the property of the permeability T at the time of a transparency mold display In spite of being so-called difference, the Takashina tone display can be carried out to a reflective mold display and a transparency mold display at the maximum using the slope of each characteristic curve of the **** reflection factor R shown in drawing 7 , and permeability T , contrast is raised and the thing of it can be carried out. Especially the thing for which the level of the liquid crystal applied voltage for giving a halftone indication of a white display and a black display is changed by a reflective mold display and transparency mold display is very useful.

[0080] According to this operation gestalt mentioned above, a reflective mold display and a transparency mold display without duplex projection or a blot of a display can be switched and displayed, and electrochromatic display equipment high-definition by high contrast can be especially realized also in any of a reflective mold display and a transparency mold display.

[0081] (The 4th operation gestalt) The 4th operation gestalt of the liquid crystal equipment concerning this invention is explained with reference to drawing 14 from drawing 11 . The 4th operation gestalt is an operation gestalt of the TFD active-matrix-liquid-crystal equipment with which this invention is applied suitably.

[0082] First, the configuration in near the TFD driver element as an example of 2 terminal mold nonlinear device used for this operation gestalt is explained with reference to drawing 11 and drawing 12 . It is the top view where drawing 11 shows a TFD driver element here typically with a pixel electrode etc., and drawing 12 is the B-B' sectional view of drawing 11 . In addition, in order to make each class and each part material into the magnitude of extent which can be recognized on a drawing, scales are made to have differed for each class or every each part material in drawing 12 .

[0083] In drawing 11 and drawing 12, the TFD driver element 40 is formed on it by making into a substrate the insulator layer 41 formed on the transparency substrate 2, consists of the 1st metal membrane 42, an insulating layer 44, and the 2nd metal membrane 46 sequentially from an insulator layer 41 side, and has TFD structure (Thin Film Diode) or MIM structure (Metal Insulator Metal structure). And the 1st metal membrane 42 of the TFD driver element 40 is connected to the scanning line 61 formed on the transparency substrate 2, and the 2nd metal membrane 46 is connected to the pixel electrode 62 which consists of conductive reflective film which is other examples of the 2nd electrode. In addition, it may replace with the scanning line 61, the data line (it mentions later) may be formed on the transparency substrate 2, it may connect with the pixel electrode 62, and the scanning line 61 may be formed in an opposite substrate side.

[0084] The transparency substrate 2 consists of a substrate which has insulation, such as glass and plastics, and transparency. The insulator layer 41 which makes a substrate consists of tantalum oxide. However, an insulator layer 41 is formed in the 1st metal membrane 42 considering an impurity not being spread as a key objective from that the 1st metal membrane 42 does not exfoliate from a substrate by heat treatment performed after deposition of the 2nd metal membrane 46 etc., and a substrate. Therefore, when these exfoliations or diffusion of an impurity do not pose a problem by constituting the transparency substrate 2 from a substrate which was excellent in thermal resistance or purity like for example, the quartz substrate etc., an insulator layer 41 can be omitted. The 1st metal membrane 42 consists of a conductive metal thin film, for example, consists of a tantalum simple substance or a tantalum alloy. an insulator layer 44 -- for example, formation -- it consists of an oxide film formed in the front face of the 1st metal membrane 42 of anodic oxidation in liquid. The 2nd metal membrane 46 consists of a conductive metal thin film, for example, consists of a chromium simple substance or a chromium alloy.

[0085] The field which light, such as a slit of a rectangle or a square and detailed

opening, penetrates like each operation gestalt mentioned above is prepared, or the pixel electrode 62 is formed for every pixel smaller than the transparent electrode on an opposite substrate, and consists of especially these operation gestalten possible [transparency of light] through the gap. Moreover, the pixel electrode 62 may consist of single reflective film, and may consist of layered products of a reflecting layer and a transparent electrode layer.

[0086] Furthermore, the transparence insulator layer 29 is formed in the side (drawing Nakagami side front face) which faces the liquid crystal of the pixel electrode 62, the TFD driver element 40, and scanning-line 61 grade, and the orientation film 19 with which it consisted of organic thin films, such as a polyimide thin film, and predetermined orientation processing of rubbing processing etc. was performed is formed on it.

[0087] As mentioned above, although some examples of a TFD driver element were explained as a 2 terminal mold nonlinear device, 2 terminal mold nonlinear device which has bidirectional diode characteristics, such as a ZnO (zinc oxide) varistor, an MSI (Metal Semi-Insulator) driver element, and RD (Ring Diode), is applicable to the high-reflective-liquid-crystal equipment of this operation gestalt.

[0088] Next, the TFD driver element constituted like is explained above with reference to drawing 13 and drawing 14 about the configuration and actuation of the transfective high-reflective-liquid-crystal equipment of a TFD active-matrix drive method which are constituted by having and which are the 4th operation gestalt. It is the partial fracture perspective view in which drawing 13 is the representative circuit schematic having shown the liquid crystal device with the drive circuit, and drawing 14 shows a liquid crystal device typically here.

[0089] In drawing 13 , the transfective high-reflective-liquid-crystal equipment of a TFD active-matrix drive method is connected to the Y driver circuit 100 where two or more scanning lines 61 arranged on the transparence substrate 2 constitute an example of the 1st supply means, and two or more data lines 60 arranged on the opposite substrate are connected to the X driver circuit 110 which constitutes an example of the 2nd supply means. In addition, the Y driver

circuit 100 and the X driver circuit 110 may be formed the transparence substrate 2 or on that opposite substrate, and serve as drive circuit built-in transfective high-reflective-liquid-crystal equipment in this case. Or with transfective high-reflective-liquid-crystal equipment, it may consist of the independent exteriors IC, you may connect with the scanning line 61 or the data line 60 through predetermined wiring, and the Y driver circuit 100 and the X driver circuit 110 serve as transfective high-reflective-liquid-crystal equipment which does not include a drive circuit in this case.

[0090] In each matrix-like pixel field, the scanning line 60 is connected to one terminal of the TFD driver element 40 (refer to drawing 11 and drawing 12), and the data line 60 is connected to the other-end child of the TFD driver element 40 through the liquid crystal layer 3 and the pixel electrode 62. Therefore, if a scan signal is supplied to the scanning line 61 corresponding to each pixel field and a data signal is supplied to the data line 60, the TFD driver element 40 in the pixel field concerned will be in an ON state, and driver voltage will be impressed to the liquid crystal layer 3 between the pixel electrode 62 and the data line 60 through the TFD driver element 40. And in a bright place, when the pixel electrode 62 reflects outdoor daylight, a reflective mold display is performed, and when opening of the pixel electrode 62 penetrates the light source light from a back light, a transparency mold display is performed in a dark place.

[0091] In drawing 14 , transfective high-reflective-liquid-crystal equipment is equipped with the transparence substrate 2 and the transparence substrate (opposite substrate) 1 by which opposite arrangement is carried out at this. The transparence substrate 1 consists of a glass substrate. The pixel electrode 62 is formed in the transparence substrate 2 in the shape of a matrix, and each pixel electrode 62 is connected to the scanning line 61. It is extended in the direction which intersects the scanning line 61, and two or more data lines 60 as a transparent electrode arranged in the shape of a strip of paper are formed in the transparence substrate 1. The data line 60 consists of transparent conductive thin films, such as for example, ITO (Indium Tin Oxide) film. The orientation film 9

with which it consisted of organic thin films, such as a polyimide thin film, and predetermined orientation processing of rubbing processing etc. was performed is formed in the data-line 60 bottom. Furthermore, the non-illustrated color filter which becomes the transference substrate 1 from the color-material film arranged the shape of the shape of a stripe and a mosaic, in the shape of a triangle, etc. according to the application is prepared.

[0092] As explained above, according to the transfective high-reflective-liquid-crystal equipment of the TFD active-matrix drive method of the 4th operation gestalt The electrochromatic display equipment which can switch and display a reflective mold display and a transparency mold display without duplex projection or a blot of a display is realizable. By switching a setup of the driver voltage to the gradation level of image data in the time of a reflective mold display and a transparency mold display, image display high-definition by high contrast can be performed also at the time of a transparency mold display also at the time of a reflective mold display. Transfective high-reflective-liquid-crystal equipment can be driven in NOMA reeve rack mode by the armature-voltage control in X and the Y driver circuits 110 and 100 which constitute especially an example of a driving means.

[0093] (The 5th operation gestalt) Next, the configuration and actuation in an operation gestalt of 1 concerning the driving gear which drives the liquid crystal equipment of the transfective reflective mold of the TFD active-matrix drive method mentioned above are explained with reference to drawing 19 from drawing 15 including the Y driver circuit 110 and the X driver circuit 110 which were shown in drawing 13 . In addition, drawing 16 is the wave form chart of the 1st GCP signal and the 2nd GCP signal, drawing 15 is the block diagram showing the concrete configuration of a driving gear, and drawing 18 is [drawing 17 is the block diagram of the part which drives the one data line in X driver circuit, and] a timing chart which shows the wave of various signals and the time relation to a driving gear. Drawing 19 is a property Fig. showing change of the ON width of face of the 1-pixel impression signal pulse of 1H to each gradation

level throughout.

[0094] each of a 1st and 2nd supply means to supply the applied voltage which has the actual value of the magnitude according to the gradation level gradation data (indicative data) indicate a driving gear to be as shown in drawing 15 to a liquid crystal device (body part of the liquid crystal equipment except a drive circuit) -- an example -- it has the Y driver circuit 110 and the X driver circuit 110. A driving gear by switching a setup of each pulse width of the data signal over each gradation level in the X driver circuit 110 A setup of each magnitude of the actual value of the applied voltage to each gradation level is switched to a setup for a reflective mold display according to the astigmatism LGT of light source lamp 212a. And the driver control circuit 310 which constitutes an example of the 2nd control means switched to a setup for a transparency mold display according to lighting of light source lamp 212a, It has further the control power supply circuit 320 which supplies the control voltage of predetermined high potential, low voltage, and a reference potential to the Y driver circuit 100 and the X driver circuit 110, and the lighting control circuit 330 which controls lighting and the astigmatism LGT (putting out lights) of light source lamp 212b.

[0095] The driver control circuit 310 The 1st GCP generation circuit 311 which generates the 1st GCP (gray-scale control pulse) signal and the 2nd GCP signal used as the foundation of the Pulse Density Modulation at the time of generating the data signal of the pulse width according to the gradation level in the X driver circuit 110 like the after-mentioned, respectively And the 2nd GCP generation circuit 312 and the data control circuit 313 which will change into the data signal of a predetermined format and will be outputted to the X driver circuit 110 if the gradation data of RGB are inputted, Various kinds of control signals, such as X clock signal, a Vertical Synchronizing signal, and a Horizontal Synchronizing signal, A timing signal etc. is inputted, and it has the LCD driving signal generation circuit 314 which generates the LCD driving signal which controls the generation timing of the 1st and 2nd GCP signal in the 1st and 2nd GCP generation circuits 311 and 312, and is constituted.

[0096] The 1st GCP generation circuit 311 generates the 1st GCP signal used as the criteria of a setup of the pulse width for an above-mentioned reflective mold display which consists of two or more pulses arranged corresponding to the unit of gradation level.

[0097] The 2nd GCP generation circuit 312 generates the 2nd GCP signal used as the criteria of a setup of the pulse width for an above-mentioned transparency mold display which consists of two or more pulses arranged corresponding to the unit of gradation level.

[0098] As shown in drawing 16, the 1st and 2nd GCP signal has a mutually different pulse array, and the data signal supplied from the X driver circuit 110 based on the 1st GCP signal differs in the pulse width to the same gradation data from the data signal supplied from the X driver circuit 110 based on the 2nd GCP signal. The 1st and 2nd GCP signal consists of a total of $N-2$ pulses to the pulse corresponding to the pulse width of the data signal for displaying gradation level $(N-1)$ from the pulse corresponding to the pulse width of the data signal for displaying gradation level (1) , respectively in the case of the gradation data of N gradation, and it is arranged, respectively so that pulse separation may correspond to a unit of gradation level.

[0099] Such 1st and 2nd GCP generation circuits 311 and 312 consist of OR circuits which calculate two or more comparator circuits and the OR of these comparison results, and compare beforehand the electrical-potential-difference value of a LCD driving signal with two or more kinds of electrical-potential-difference values set to the object for a reflective mold display, or the transparency mold display based on the change width of face of the pulse width to a unit of each gradation level by these comparator circuits, respectively. And by calculating the OR of the comparison result of these comparator circuits, it is constituted so that the 1st and 2nd GCP signal as shown in drawing 16 which consists of a train of the pulse which is $N-2$ per one selection period from which spacing differs as the operation output corresponding to the change width of face of the pulse width according to a unit of each gradation level may be generated.

[0100] Again, in drawing 15 , the driver control circuit 310 is further equipped with the pulse signal switch 315 which supplies alternatively either of such 1st and 2nd GCP signals to the X driver circuit 110. And synchronizing with the lighting control using the lighting switch 331 by the lighting control circuit 330, the pulse signal switch 315 switches the pulse signal switch 315 so that the 2nd GCP signal may be supplied, while supplying the 1st GCP signal synchronizing with the astigmatism LGT (putting out lights) control using the lighting switch 331 by the lighting control circuit 330. In addition, lighting and astigmatism LGT control by the lighting control circuit 330 detect the manual switch actuation by the user, and outdoor daylight reinforcement, and are performed by the automatic-switch actuation based on the detection result. Then, the pulse signal switch 315 cuts and replaces synchronizing with control of this lighting and an astigmatism LGT. Therefore, according to the astigmatism LGT (putting out lights) of light source lamp 212a, and lighting, it can switch to a positive setup [be / no delay] for a reflective mold display, and a setup for a transparency mold display.

[0101] In addition, as shown in drawing 15 , you may constitute so that it may carry out based on the lighting control signal Smode sent to the lighting switch 331 from the lighting control circuit 330, but the switch actuation in such a pulse signal switch 315 may be constituted so that it may perform that light source lamp 212a was turned on or switched off based on the detecting signal from the detector to detect.

[0102] In drawing 15 the control power supply circuit 320 The X side power supply circuit 321 which supplies control voltage, such as an electrical potential difference (VHX) of high potential used for data signal generation of the X driver circuit 110, an electrical potential difference (VLX) of low voltage, and an electrical potential difference (VCX) of a reference potential, The Y driver circuit 100 is equipped with the Y side power supply circuit 322 which supplies control voltage, such as an electrical potential difference (VHY) of high potential used for scan signal generation, an electrical potential difference (VLY) of low voltage, and an electrical potential difference (VCY) of a reference potential, and is

constituted.

[0103] As shown in drawing 17 , the indicative data of the format of the digital signal which consists of predetermined number bits which show one of 64 kinds of gradation level (gradation level 0-63), for example, such as 6 etc. bits, from the data control circuit 313 (refer to drawing 15) of the driver control circuit 310 is inputted into X driver circuit partial 110a which supplies a data signal to the one data line of the X driver circuit 110 about each pixel, respectively. Moreover, FR signal which are Horizontal Synchronizing signal HSYNC of an indicative data, the reference clock XCK for X driver circuit 110, the RES signal that is a pulse signal emitted for every selection period, and a binary signal which it is at the initiation [of one selection period] and termination time, and a voltage level reverses, respectively is inputted. Moreover, electrical potential differences VHX, VCX, and VLX are supplied from the control power supply circuit 330 (refer to drawing 15) as a power source for data signal generation. Furthermore, especially with the gestalt of this operation, a GCP signal (the 1st or 2nd GCP signal) is supplied from the pulse signal switch 315 of the driver control circuit 310.

[0104] In drawing 17 , X driver circuit partial 110a is equipped with a shift register 401, a latch circuit 402, the gray-scale control circuit 403, the GCP decoder circuit 404, the FR decoder circuit 405, the level-shifter circuit 406, and the LCD driver 408, and is constituted.

[0105] For every bit of a predetermined number, sequential maintenance will be carried out and X driver circuit partial 110a will go to a shift register 401, if an indicative data is inputted. The latch circuit 402 has the latch section corresponding to two or more data lines and one to one correspondences, and will be anew latched to this latch circuit 402 in the place where all the indicative datas for 1 level Rhine were held by performing the transfer to the shift register 401 of an indicative data one by one.

[0106] Here, the GCP decoder 404 generates a signal with the pulse width corresponding to the gradation level which each indicative data (digital value) of

the predetermined number bit in a latch circuit 402 shows in response to control by the gray-scale control circuit 403 according to the GCP signal which consists of a train of the pulse of the predetermined number per one selection period.

[0107] The FR decoder 405 outputs a data signal with the wave which reversed the electrical-potential-difference polarity of the signal output of the GCP decoder circuit 404 for every selection period using FR signal which is a binary signal which changes a voltage level for every selection period. More specifically according to MSB of the latched indicative data (digital value), ON / off signal of each transistor which constitutes the LCD driver 408 about each selection period are generated. Thus, it is for carrying out the alternating current drive of the liquid crystal to make every selection period (1H period) reverse the voltage level of the data signal corresponding to ON, and ON/OFF state voltage of a scan signal are also reversed every 1H period.

[0108] Thus, ON / off signal of each transistor in the generated LCD driver 408 are shifted to the voltage level corresponding to each data line by the level-shifter circuit 406. And if the ON / off signal with which the voltage level was shifted are inputted into each gate, each transistor of the LCD driver circuit 408 will be turned on / turned off, respectively, and let the electrical-potential-difference value of each pulse be the electrical-potential-difference value specified with the combination of two or more electrical potential differences VHX, VCX, and VLX connected to each source or a drain.

[0109] All the digital signals for 1 level Rhine will be held by the X driver circuit 110 (refer to the drawing 1515) which comes to contain two or more X driver circuit partial 110a constituted as mentioned above, and two or more data lines 14 will be supplied at coincidence.

[0110] The above actuation is further explained with reference to the timing chart of drawing 18 .

[0111] As shown in drawing 18 , an RES signal is inputted into the X driver circuit 110 for every selection period, the GCP signal which becomes one selection period from the train of 62 pulses (=N-2 piece: in the case of 64 gradation) is

inputted into it in parallel to this, and the indicative data (digital signal) which shows the gradation level 2, the gradation level 5, and the gradation level 0 about a specific pixel is further inputted into it per field. Then, based on a GCP signal, level of a data signal is set to ON by the GCP decoder 404 to the timing of the 2nd or the 5th pulse of those. And based on FR signal, the polarity of the ON state voltage of a data signal or OFF state voltage is reversed by the FR decoder 405 for every selection period, and the data signal which takes further predetermined peak value is outputted.

[0112] Under the present circumstances, in the time rate that a data signal takes binary [in 1 selection period (1H period)], and the permeability of a liquid crystal panel, generally, linear relation does not become. For example, in the case of 64 gradation, each gradation level 0 (for example, black), 1, 2, --, 63 (for example, white) obtained when changing the width of face which takes ON of 1 H term throughout, and the ON width of face concerned have relation as shown in the graph of drawing 19 with the property of liquid crystal, the property of a liquid crystal panel, etc. For this reason, the gradation display in the gestalt of this operation is changing the ON width of face of a data signal according to the gradation level which input data shows based on such relation. Namely, since the rate of change of ON width of face decreases and goes so that the gradation level 63 side is approached from the gradation level 0 side In order to control the difference of slighter ON width of face, as shown in the 2nd step from on drawing 16 or drawing 18 The GCP signal which consists of a train of the pulse of a "-two gradation" individual (for example, the case of 64 gradation 62 pieces) is generated so that spacing may differ corresponding to the difference of the ON width of face of the data signal according to the difference of gradation level. That is, under relation like drawing 19 , the 1st and 2nd GCP signal which consists of a train of the pulse which is 62 pieces to which spacing becomes narrow gradually is generated in the 1st and 2nd GCP generation circuits 311 and 312, respectively as gradation level goes up.

[0113] Based on a GCP signal (the 1st or 2nd GCP signal) with such a property,

as for a data signal, only the period from the 2nd pulse in a GCP signal to termination of the 1H period concerned is set to ON (for example, high-voltage level) among 1H corresponding periods to the gradation level 2 in drawing 18 . Next, as for a data signal, only the period from the 5th pulse in a GCP signal to termination of the 1H period concerned is set to ON (for example, low-battery level) among 1H corresponding periods to the gradation level 5. Moreover, a data signal is set to OFF (for example, high-voltage level) to the corresponding last of 1H period to the gradation level 0 next.

[0114] And as shown in the bottom of drawing 18 , only the period corresponding to the ON width of face of the data signal with which the impression signal (= scan signal-data signal) impressed to one pixel electrode (namely, pixel electrode connected between the one data line with which the indicative data of illustration is supplied, and scanning line (eye N line)) corresponds makes the TFD driver element concerned an ON state (low resistance condition) exceeding the threshold of a TFD driver element. Consequently, the effective voltage corresponding to the ON width of face of a data signal is applied to a part for the liquid crystal layer pinched by a pixel electrode and the data line concerned, or the scanning line.

[0115] Thus, the ON width of face of a data signal determines the transmission in each pixel of a liquid crystal panel, and the display corresponding to an indicative data is performed as the whole liquid crystal panel.

[0116] The above result, with the driving gear of the gestalt of this operation, a reflective mold display can be performed at the time of a light source lamp 212a astigmatism LGT, and a transparency mold display can be performed at the time of light source lamp 212a lighting.

[0117] Especially with the gestalt of this operation, a setup of each magnitude of the actual value of the applied voltage to each gradation level in the X driver circuit 110 is switched to a setup for a reflective mold display here according to the astigmatism LGT of light source lamp 212a by the pulse signal switch 315 (refer to the drawing 1515) of the driver control circuit 310, or it is switched to a

setup for a transparency mold display according to lighting of light source lamp 212a.

[0118] Therefore, the relation which suited the property of permeability T over the driver voltage which showed the relation between gradation level and the reflection factor at the time of a reflective mold display to drawing 7, Namely, a setup of each pulse width of a data signal [as opposed to / so that it may consider as the relation which makes the most of the slope of the characteristic curve of transmission T / each gradation level] If (spacing of each pulse over a unit of each gradation level in the 1st GCP signal shown in drawing 16 is specifically set up), the contrast at the time of a transparency mold display will be raised efficiently. If each pulse width of the data signal over each gradation level sets as coincidence so that it may carry out to the relation which suited the property of a reflection factor R over the driver voltage shown in drawing 7, i.e., the relation which makes the most of the slope of the characteristic curve of a reflection factor R , (a setup of spacing of each pulse over a unit of each gradation level in the 1st GCP signal specifically shown in drawing 16), the contrast at the time of a reflective mold display will raise efficiently.

[0119] As explained above, according to the liquid crystal equipment of the 5th operation gestalt, neither the duplex projection by parallax nor a blot of a display occurs, but image display high-definition by high contrast becomes possible also at the time of a transparency mold display also at the time of a reflective mold display.

[0120] Moreover, since the comparatively easy switch actuation by the pulse signal switch 315 can perform [quickly and] a switch with a reflective mold display mode and a transparency mold display mode with the gestalt of this operation, it is convenient practically.

[0121] (The 6th operation gestalt) Next, the configuration and actuation in an operation gestalt of the others concerning the driving gear which drives the liquid crystal equipment of the transfective reflective mold of the TFD active-matrix drive method mentioned above are explained with reference to drawing 21 from

drawing 20 including the Y driver circuit 110 and the X driver circuit 110 which were shown in drawing 13 . In addition, drawing 20 is the block diagram showing the concrete configuration of a driving gear, drawing 21 is the conceptual diagram showing the wave of two kinds of scan signals, and drawing 21 is the property Fig. of permeability (T) to the peak value (DC electrical potential difference) of a scan signal. In addition, in drawing 20 , the reference mark same about the same component as the case of the 5th operation gestalt shown in drawing 15 is attached, and the explanation is omitted.

[0122] drawing 20 -- being shown -- as -- a driving gear -- the -- five -- operation - a gestalt -- it can set -- the -- one -- and -- the -- two -- GCP -- generation -- a circuit -- 311 -- and -- 312 -- lists -- a pulse signal -- a switch -- 315 -- replacing with -- being single -- GCP -- generation -- a circuit -- 311 -- ' -- having had -- a driver -- a control circuit -- 310 -- ' -- having . the control power supply circuit [in / in a driving gear / the 5th operation gestalt] 320 -- replacing with -- the [the 1st and] -- the [the 2Y side power supply circuits 323 and 324 and / the 1st and] -- it has control power supply circuit 320' including the control voltage switch 325 which supplies alternatively the control voltage from the 2Y side power supply circuits 323 and 324 to the Y driver circuit 100. This control voltage switch 325 performs change-over actuation based on the lighting control signal Smode supplied from the lighting control circuit 330. About other configurations, it is the same as that of the case of the 5th operation gestalt shown in drawing 15 .

[0123] here -- especially -- control power supply circuit 320' -- an example of the 2nd control means -- constituting -- **** -- the -- the 1Y side power supply circuit 323 supplies the electrical potential difference (VHY1) of high potential used as the criteria of a setup of the peak value of the scan signal for a reflective mold display, the electrical potential difference (VLY1) of low voltage, and the electrical potential difference (VCY1) of a reference potential as the 1st control voltage of a lot. the [on the other hand,] -- the 2Y side power supply circuit 324 supplies the electrical potential difference (VHY2) of high potential which serves as criteria of a setup of the peak value of the scan signal for a transparency mold display as

an example of the 2nd control voltage, the electrical potential difference (VLY2) of low voltage, and the electrical potential difference (VCY2) of a reference potential as the 2nd control voltage of a lot. And the control voltage switch 325 is constituted so that the 1st control voltage may be alternatively supplied to the Y driver circuit 100 according to the astigmatism LGT of light source lamp 212a and the 2nd control voltage may be alternatively supplied to the Y driver circuit 100 according to lighting of light source lamp 212a.

[0124] Therefore, with the 6th operation gestalt, the data signal which has the pulse width according to gradation level is supplied to the data line by the X driver circuit 110. In parallel to this, the scan signal which has the peak value corresponding to the 1st or 2nd control voltage by the Y driver circuit 100 while having predetermined width of face is supplied to the scanning line.

[0125] Drawing 21 is the wave form chart of an example of two kinds of scan signals generated in this way.

[0126] In drawing 21, only the latter peak value of ΔV is higher than the former peak value by the scan signal (inside of drawing, left-hand side) set to the reflective mold display generated based on the 1st control voltage, and the scan signal (inside of drawing, right-hand side) set to the transparency mold display generated based on the 2nd control voltage. Therefore, in no MARI White mode, since only ΔV has the large electrical-potential-difference value of applied voltage, as for the brightness of a display, the direction at the time of driving with the scan signal at the time of a transparency mold display becomes dark. Namely, since only ΔV has the small electrical-potential-difference value of applied voltage, as for the brightness of a display, the direction at the time of driving with the scan signal at the time of a reflective mold display becomes bright.

[0127] Therefore, the relation which suited the property of permeability T over the driver voltage which showed the relation between gradation level and the reflection factor at the time of a reflective mold display to drawing 7, That is, if the 2nd control voltage to each gradation level is set up so that it may consider as the relation which makes the most of the slope of the characteristic curve of

transmission T (specifically setup of the value of electrical potential differences VHY2, VLY2, and VCH2), the contrast at the time of a transparency mold display will be raised efficiently. If the 1st control voltage to each gradation level is set as coincidence so that it may carry out to the relation which suited the property of a reflection factor R over the driver voltage shown in drawing 7 , i.e., the relation which makes the most of the slope of the characteristic curve of a reflection factor R, (specifically setup of the value of electrical potential differences VHY1, VLY1, and VCH1), the contrast at the time of a reflective mold display will be raised efficiently.

[0128] As explained above, according to the liquid crystal equipment of the 6th operation gestalt, neither the duplex projection by parallax nor a blot of a display occurs, but image display high-definition by high contrast becomes possible also at the time of a transparency mold display also at the time of a reflective mold display. In addition, it asks [value / of the electrical potential differences VHY1, VLY1, VCY1, VHY2 VLY2, and VCY2 which constitute the 1st and 2nd concrete control voltage / each] by experimental, theoretical, a simulation, etc. beforehand about liquid crystal equipment. Moreover, although the electrical potential difference VHY1 (VHY2) of high potential, the electrical potential difference VLY1 (VLY2) of low voltage, and the electrical potential difference VCY1 (VCY2) of a reference potential are required to adopt the drive method which reverses applied voltage for every selection period As shown in drawing 21 , as long as peak value is switched, two of three electrical potential differences are good also as one or the same potential between the 1st control voltage and the 2nd control voltage. That is, not three but two or one are sufficient as the electrical potential difference actually switched with a switch. Moreover, if an above-mentioned reversal drive is not carried out, the 1st and 2nd control voltage may consist of an electrical potential difference of a pair, respectively.

[0129] Since the comparatively easy switch actuation by the control voltage switch 325 can perform [quickly and] a switch with a reflective mold display mode and a transparency mold display mode especially with the gestalt of this

operation, it is convenient practically.

[0130] Although it was made to perform gradation control by making equivalent to gradation level quantity of electricity specified with the width of face and peak value of a pulse which make a data signal based on the so-called "4 Value driving method", and becoming irregular with the above 5th and 6th operation gestalt, according to this invention, it is also possible to perform such gradation control based on the charge-and-discharge driving method indicated by JP,2-125225,A etc., for example.

[0131] (The 7th operation gestalt) The 7th operation gestalt of the liquid crystal equipment concerning this invention is explained with reference to drawing 24 from drawing 22 . The 7th operation gestalt is an operation gestalt of the TFT active-matrix-liquid-crystal equipment with which this invention is applied suitably. Drawing 22 is equal circuits, such as various components in two or more pixels formed in the shape of [which constitutes the image display field of liquid crystal equipment] a matrix, and wiring, drawing 23 is a top view of two or more pixel groups where the transference substrate with which the data line, the scanning line, a pixel electrode, etc. were formed adjoins each other, and drawing 24 is the C-C' sectional view of drawing 23 . In addition, in order to make each class and each part material into the magnitude of extent which can be recognized on a drawing, scales are made to have differed for each class or every each part material in drawing 24 .

[0132] In drawing 22 , two or more formation is carried out at the shape of a matrix, and TFT130 for controlling the pixel electrode 62 which are other examples of the 2nd electrode arranged in the shape of a matrix by the transfective high-reflective-liquid-crystal equipment of the TFT active matrix of the 7th operation gestalt is connected in the source of TFT130 electrically [the data line 135 with which a picture signal is supplied]. The picture signals S1, S2, --, Sn written in the data line 135 may be supplied to line sequential, and you may make it supply them to this order for every group to two or more data-line 135 comrades which adjoin each other. Moreover, the scanning line 131 is

electrically connected to the gate of TFT130, and it consists of predetermined timing so that the scan signals G1, G2, --, Gm may be impressed to the scanning line 131 in pulse line sequential at this order. It connects with the drain of TFT130 electrically, and the pixel electrode 62 writes in the picture signals S1, S2, --, Sn supplied from the data line 135 in TFT130 which is a switching element when only a fixed period closes the switch to predetermined timing. Fixed period maintenance of the picture signals S1, S2, --, Sn of the predetermined level written in liquid crystal through the pixel electrode 62 is carried out between the counterelectrodes (it mentions later) formed in the opposite substrate (it mentions later). Here, in order to prevent the held picture signal leaking, storage capacitance 170 is added to the liquid crystal capacity and juxtaposition which are formed between the pixel electrode 62 and a counterelectrode.

[0133] In drawing 23, on the transparency substrate 2 as a TFT array substrate, the pixel electrode 62 (the profile 62a is shown by the drawing middle point line) which consists matrix-like of reflective film is formed, and the data line 135, the scanning line 131, and the capacity line 132 are formed respectively along the boundary of the pixel electrode 62 in every direction. Electrical installation of the data line 135 is carried out to the source field among semi-conductor layer 81a which consists of polysilicon film etc. through a contact hole 85. Electrical installation of the pixel electrode 62 is carried out to the drain field among semi-conductor layer 81a through the contact hole 88. The capacity line 132 is carrying out opposite arrangement at the 1st storage capacitance electrode installed from the drain field of the semi-conductor layer 1a through the insulator layer, and constitutes storage capacitance 170. Moreover, the scanning line 131 is arranged so that channel field 81a' shown in the slash field of a Fig. Nakamigi riser among semi-conductor layer 81a may be countered, and the scanning line 131 functions as a gate electrode. Thus, TFT130 by which opposite arrangement of the scanning line 131 was carried out as a gate electrode is formed in the crossing part of the scanning line 131 and the data line 135 at channel field 81a', respectively.

[0134] As shown in drawing 24 , liquid crystal equipment is equipped with the transperence substrate 2 and the transperence substrate (opposite substrate) 1 by which opposite arrangement is carried out at this. These transperence substrates 1 and 2 consist of a substrate which has insulation, such as a quartz, glass, and plastics, and transparency, respectively.

[0135] The field which light, such as a slit of a rectangle or a square and detailed opening, penetrates like each operation gestalt mentioned above is prepared, or the pixel electrode 62 is formed for every pixel smaller than the transparent electrode on an opposite substrate, and consists of especially these operation gestalten possible [transparency of light] through the gap. Moreover, the pixel electrode 62 may consist of single reflective film, and may consist of layered products of a reflecting layer and a transparent electrode layer.

[0136] Furthermore, the transperence insulator layer 29 is formed in the side (drawing Nakagami side front face) which faces the liquid crystal of the pixel electrode 62 and TFT130 grade, and the orientation film 19 with which it consisted of organic thin films, such as a polyimide thin film, and predetermined orientation processing of rubbing processing etc. was performed is formed on it.

[0137] On the other hand, the 2nd light-shielding film 122 called a black mask or the Black matrix is formed in the non-[which the counterelectrode 121 as other examples of a transparent electrode is mostly formed in the whole surface, and is each pixel] opening field at the transperence substrate 1. The orientation film 9 with which it consisted of organic thin films, such as a polyimide thin film, and predetermined orientation processing of rubbing processing etc. was performed is formed in the counterelectrode 121 bottom. Furthermore, the non-illustrated color filter which becomes the transperence substrate 1 from the color-material film arranged the shape of the shape of a stripe and a mosaic, in the shape of a triangle, etc. according to the application prepares, and it is ****.

[0138] TFT130 for pixel switching which carries out switching control of each pixel electrode 62 is formed in the location contiguous to each pixel electrode 62 at the transperence substrate 2.

[0139] Thus, it is constituted, and among the transparence substrates 1 and 2 of the pair arranged so that the pixel electrode 62 and a counterelectrode 121 may meet, liquid crystal is enclosed with the space surrounded by the sealant like the case of the 1st operation gestalt, and the liquid crystal layer 3 is formed.

[0140] Furthermore, the 1st interlayer insulation film 112 is formed in the bottom of two or more TFT30 for pixel switching. The 1st interlayer insulation film 112 functions as substrate film for TFT30 for pixel switching by being formed all over the transparence substrate 2. The 1st interlayer insulation film 112 consists of high insulation glass, such as NSG (non doped silicate glass), PSG (phosphorus silicate glass), BSG (boron silicate glass), and BPSG (boron phosphorus silicate glass), or silicon oxide film, a silicon nitride film, etc.

[0141] In drawing 24 , TFT130 for pixel switching is constituted including the drain field connected to the pixel electrode 62 through the source field connected to the data line 135 through the contact hole 85, channel field by which opposite arrangement was carried out through gate dielectric film at the scanning line 131 81a', and a contact hole 88. the data line 131 -- aluminum etc. -- low -- it consists of protection-from-light nature and conductive thin films, such as metal membrane metallurgy group silicide [****]. [, such as alloy film,] Moreover, on it, the 2nd interlayer insulation film 114 with which contact holes 85 and 88 were punctured is formed, and the 3rd interlayer insulation film 117 with which the contact hole 88 was punctured is further formed on it. It consists of high insulation glass, such as NSG, PSG, BSG, and BPSG, or silicon oxide film, a silicon nitride film as well as the 1st interlayer insulation film 112, etc. also about these 2nd and 3rd interlayer insulation films 114 and 117.

[0142] TFT130 for pixel switching may be TFT of which structures, such as LDD structure, offset structure, and self aryne structure. Furthermore, TFT130 may be constituted above others, the dual gate, or the triple gate. [structure / single gate]

[0143] Although the scanning line 131 drives the liquid crystal equipment of the transfective reflective mold of the TFT active-matrix drive method of the 7th

operation gestalt constituted like the above by X driver circuit and the data line 135 drives by Y driver circuit under the present circumstances, the liquid crystal driver voltage impressed to the liquid crystal layer 3 in the time of lighting of a lighting system, and an astigmatism LGT through a counterelectrode 121 and the pixel electrode 62 (refer to drawing 24) -- the same image -- receiving -- difference -- these counterelectrodes 121 and the pixel electrode 62 drive like. Namely, by switching one [at least] electrical-potential-difference setup according to lighting and the astigmatism LGT of a lighting system in a drive circuit among the scan signals supplied to the picture signal supplied to the data line 135, and the scanning line 131 It becomes possible to drive the liquid crystal layer 3 by the driver voltage which suited the reflection factor property over the driver voltage in the transparency mold display concerned at the time of a transparency mold display, driving the liquid crystal layer 3 by the driver voltage which suited the reflection factor property over the driver voltage in the reflective mold display concerned at the time of a reflective mold display. In this case, it is possible it not only to raise contrast with the time of a reflective mold display and a transparency mold display, but for it to be made to perform a gamma correction to coincidence further.

[0144] As explained above, according to the transfective high-reflective-liquid-crystal equipment of the TFT active-matrix drive method of the 7th operation gestalt, between the pixel electrode 62 and a counterelectrode 121 It becomes controllable about the orientation condition of each liquid crystal part by carrying out sequential impression of the electric field at the liquid crystal part in each pixel electrode 62. In a bright place, when the pixel electrode 62 reflects outdoor daylight, a reflective mold display is performed, and when opening of the pixel electrode 62 penetrates the light source light from a back light, a transparency mold display is performed in a dark place. Consequently, the electrochromatic display equipment which can switch and display a reflective mold display and a transparency mold display without duplex projection or a blot of a display can be realized, and image display high-definition by high contrast can be performed

also at the time of a transparency mold display also at the time of a reflective mold display.

[0145] In order to supply power to each pixel electrode 62 through TFT130 especially, the cross talk between the pixel electrodes 62 can be reduced, and more nearly high-definition image display becomes possible.

[0146] In addition, you may drive by horizontal electric field parallel to the substrate between the pixel electrodes 62 on the transparency substrate 2, without preparing a counterelectrode on the transparency substrate 1.

[0147] Here, the coloring layer of the color filter 5 used for the 1st to 7th [which was explained above] operation gestalt is explained with reference to drawing 25 . Drawing 25 is the property Fig. showing the permeability of each coloring layer of a color filter 5. In each operation gestalt, once incident light penetrates one coloring layer of the color filters 5, the liquid crystal layer 3 is passed and it is reflected by reflector 7 grade, and when performing a reflective mold display, after penetrating a coloring layer again, it is emitted. Therefore, since two-times passage of the color filter will be carried out unlike the liquid crystal equipment of the usual transparency mold, in the usual color filter, a display becomes dark and contrast falls. So, with each operation gestalt, as shown in drawing 2525 , it light-color-izes and forms so that the minimum permeability 61 in the visible region of each coloring layer of R, G, and B of a color filter 5 may become 25 - 50%. Light color-ization of a coloring layer is made by making thickness of a coloring layer thin or making low concentration of the pigment mixed in a coloring layer, or a color. By this, when performing a reflective mold display, it can constitute so that brightness of a display may not be reduced.

[0148] In performing a transparency mold display, in order to penetrate a color filter 5 only once, light color-ization of a display is brought about, but since many light of a back light is interrupted with a reflector with each operation gestalt in many cases, light-color-izing of this color filter 5 is convenient rather, when securing the brightness of a display.

[0149] (The 8th operation gestalt) The 8th operation gestalt of this invention is

explained with reference to drawing 26 . The 8th operation gestalt is an operation gestalt of electronic equipment equipped with any one of the 1st to 7th [which was explained above] operation gestalten. That is, the 8th operation gestalt is involved in the various electronic equipment suitably used as a display of the pocket device by which the liquid crystal equipment shown in the 1st to 7th operation gestalt mentioned above is needed for a low power under various environments. Three examples of the electronic equipment of this invention are shown in drawing 26 .

[0150] Drawing 26 (a) shows a cellular phone and a display 72 is formed in the front upper part section of a body 71. A cellular phone is used in all environments regardless of the inside-of-a-house outdoors. Although used by especially the automatic in the car one in many cases, in the car [of Nighttime] is very dark. Therefore, the display used for a cellular phone has desirable transfective high-reflective-liquid-crystal equipment to which the reflective mold display with low power consumption is made as for the transparency mold display which used the fill-in flash for Maine if needed. If the liquid crystal equipment of a publication is used for the above-mentioned 1st operation gestalt thru/or the above-mentioned 7th operation gestalt as a display 72 of a cellular phone, the transparency mold display of a reflective mold display will also be brighter than before, and a gestalt telephone with a high contrast ratio will be obtained.

[0151] Drawing 26 (b) shows a watch and a display 74 is formed in the center 73 of a body. The important viewpoint in a watch application is a high-class feeling. If the liquid crystal of a publication is used for the 1st operation gestalt thru/or the 14th operation gestalt of this invention as a display 74 of a watch, since there is little property change by the wavelength of light, coloring is also small as well as contrast being brightly high. Therefore, as compared with the conventional watch, the color display which occurs a high-class feeling very is obtained.

[0152] Drawing 26 (c) shows a portable information device, a display 76 is formed in the body 75 bottom, and the input section 77 is formed in the bottom. Moreover, a touch key is prepared in the front face of a display 76 in many cases.

Since the usual touch key has much surface reflection, a display is hard to look at it. Therefore, also although it is conventionally called a pocket mold, transparency mold liquid crystal equipment is used as a display in many cases. However, for transparency mold liquid crystal equipment, in order to always use a back light, power consumption is large, and a battery life is a short paddle. Also in this case, if the liquid crystal equipment of the above-mentioned 1st operation gestalt thru/or the 7th operation gestalt is used as a display 76 of a portable information device, a portable information device bright a display and skillful in it can be obtained also with a reflective mold, a transflective reflective mold, or a transparency mold.

[0153] The liquid crystal equipment of this invention is not restricted to each operation gestalt mentioned above, and can be suitably changed in the range which is not contrary to the summary or thought of invention which can be read in a claim and the whole specification, and the liquid crystal equipment accompanied by such modification is also contained in the technical range of this invention.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is outline drawing of longitudinal section (drawing 1 (a)) and the outline top view (drawing 1 (b)) showing the outline structure of the 1st operation gestalt of the liquid crystal equipment concerning this invention.

[Drawing 2] It is the top view showing one example of opening in the 1st operation gestalt.

[Drawing 3] It is the top view showing other examples of opening in the 1st operation gestalt.

[Drawing 4] It is the top view showing other examples of opening in the 1st operation gestalt.

[Drawing 5] It is the top view showing other examples of opening in the 1st operation gestalt.

[Drawing 6] It is the top view showing other examples of opening in the 1st operation gestalt.

[Drawing 7] It is the property Fig. showing the property of the reflection factor R at the time of the reflective mold display to the driver voltage in the liquid crystal equipment of the 1st operation gestalt, and the property of the permeability T at the time of a transparency mold display.

[Drawing 8] It is outline drawing of longitudinal section showing the outline structure of the 2nd operation gestalt of the liquid crystal equipment concerning this invention.

[Drawing 9] It is the outline length top view showing the outline structure of the pixel electrode in the 2nd operation gestalt.

[Drawing 10] It is the block diagram of the liquid crystal equipment in the 3rd operation gestalt of the liquid crystal equipment concerning this invention.

[Drawing 11] It is the top view showing typically the TFD driver element of the 4th operation gestalt concerning the liquid crystal equipment of this invention with a pixel electrode etc.

[Drawing 12] It is the B-B' sectional view of drawing 11 .

[Drawing 13] It is the representative circuit schematic having shown the liquid

crystal device in the 4th operation gestalt with the drive circuit.

[Drawing 14] It is the partial fracture perspective view showing typically the liquid crystal device in the 4th operation gestalt.

[Drawing 15] It is the block diagram of the liquid crystal panel in the 5th operation gestalt concerning the liquid crystal equipment of this invention.

[Drawing 16] It is the wave form chart of the 1st and 2nd GCP signal generated in the 5th operation gestalt.

[Drawing 17] They are some block diagrams of X driver circuit included in the driving gear with which the 5th operation gestalt was equipped.

[Drawing 18] It is the timing chart which shows actuation of the driving gear with which the 5th operation gestalt was equipped.

[Drawing 19] It is the property Fig. showing the change of the ON width of face of the pulse for the data signal drive of 1H to gradation level throughout in the 5th operation gestalt.

[Drawing 20] It is the block diagram of the liquid crystal equipment which consists of the liquid crystal panel and driving gear in the 6th operation gestalt concerning this invention.

[Drawing 21] It is the wave form chart of two kinds of scan signals generated in the 6th operation gestalt.

[Drawing 22] They are equal circuits, such as various components in two or more pixels formed in the shape of [which constitutes the image display field of the liquid crystal equipment of the 7th operation gestalt concerning this invention] a matrix, and wiring.

[Drawing 23] It is the top view of two or more pixel groups where the transparence substrate with which the data line in the 7th operation gestalt, the scanning line, a pixel electrode, etc. were formed adjoins each other.

[Drawing 24] It is the C-C' sectional view of drawing 23 .

[Drawing 25] It is the graph which shows the light transmittance for every coloring layer of the color filter in the 1st to 7th operation gestalt.

[Drawing 26] It is the outline perspective view of various kinds of electronic equipment of the 8th operation gestalt concerning this invention.

[Translation done.]

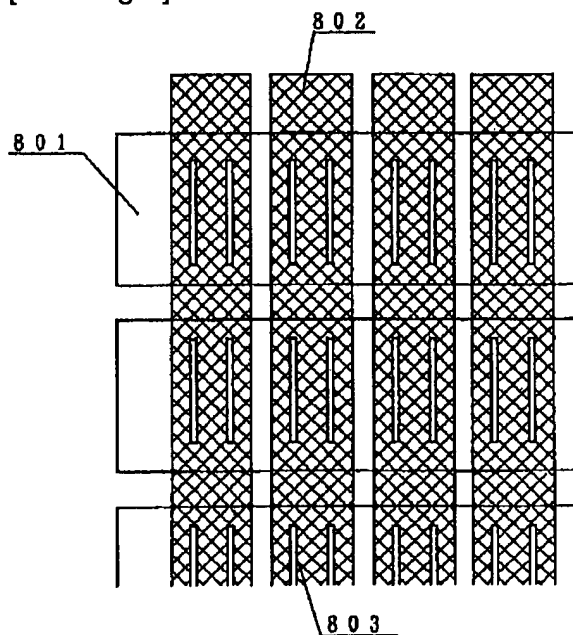
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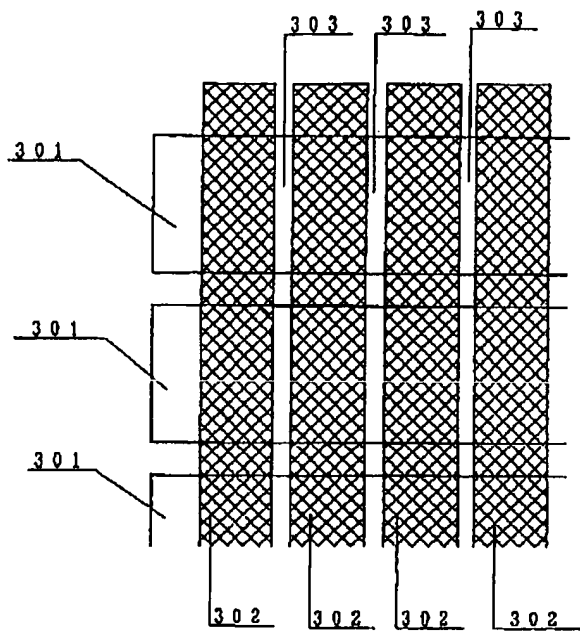
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DRAWINGS

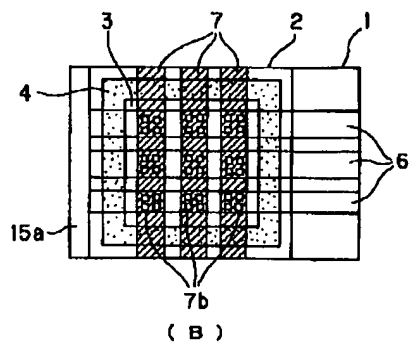
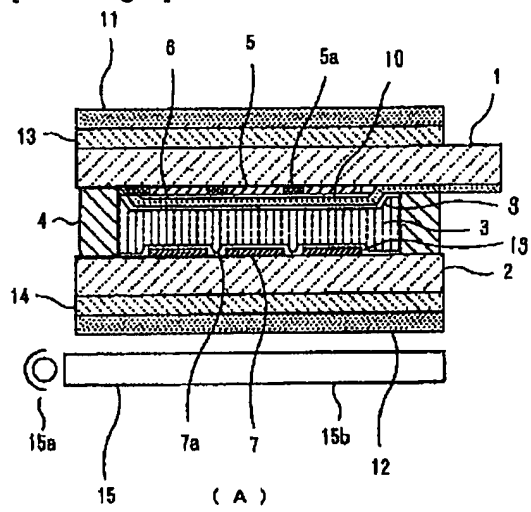
[Drawing 2]



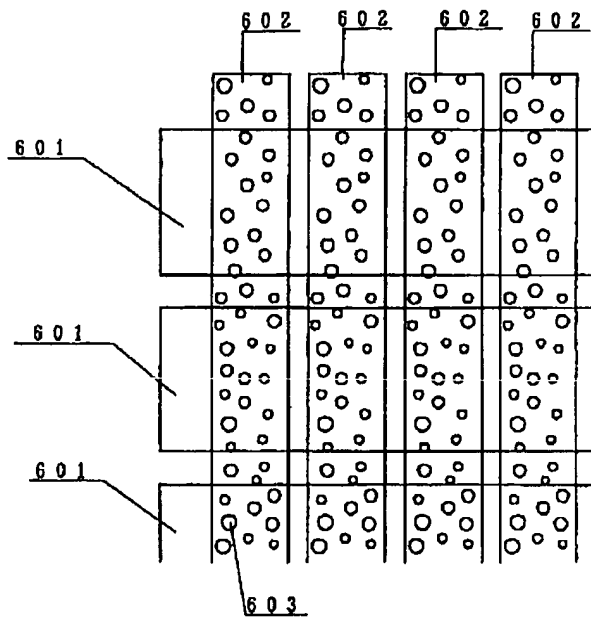
[Drawing 4]



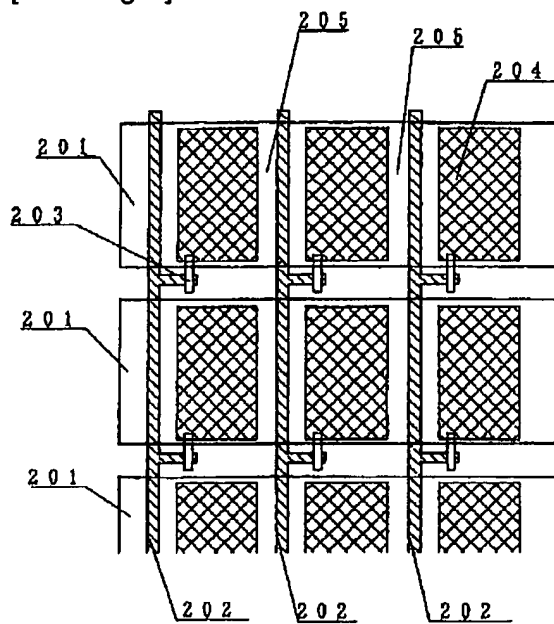
[Drawing 1]



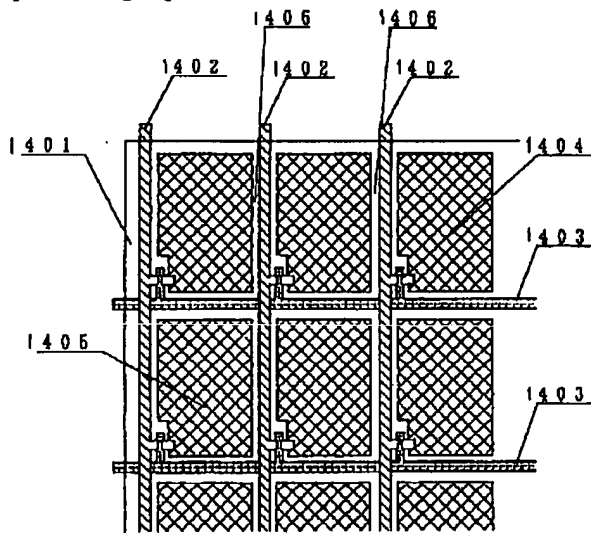
[Drawing 3]



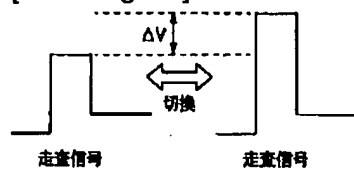
[Drawing 5]



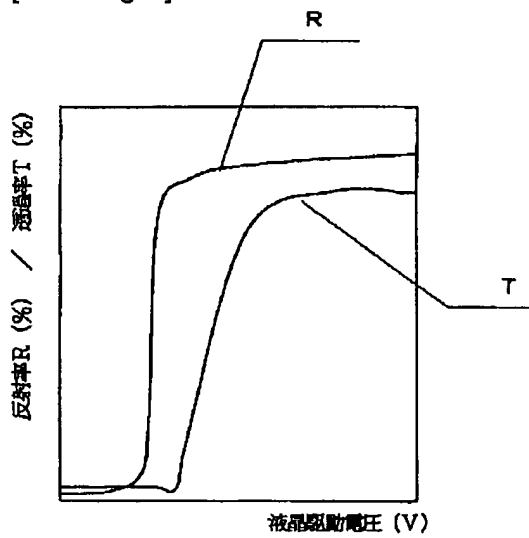
[Drawing 6]



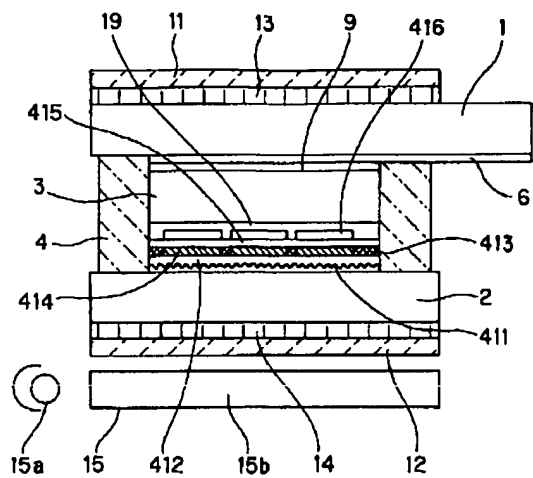
[Drawing 21]



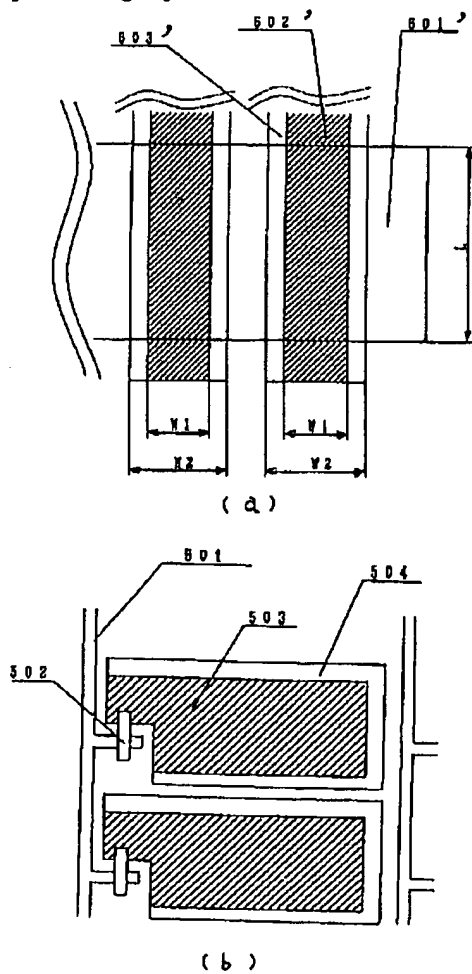
[Drawing 7]



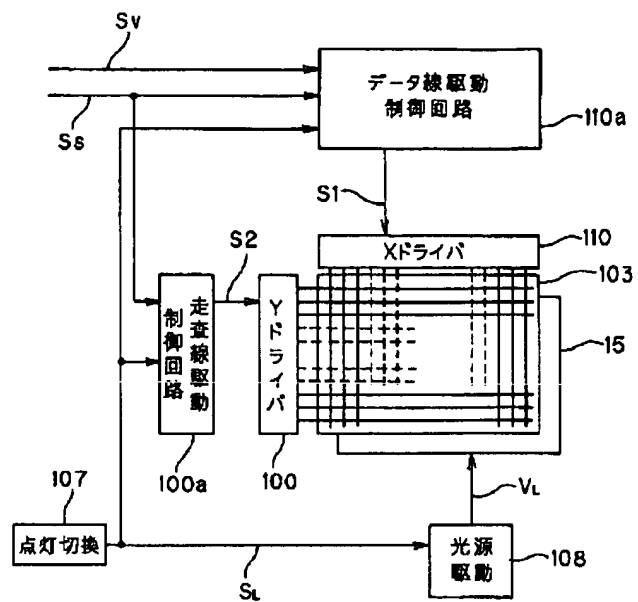
[Drawing 8]



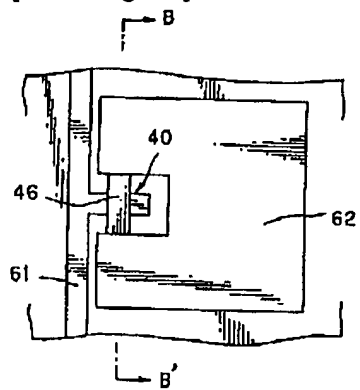
[Drawing 9]



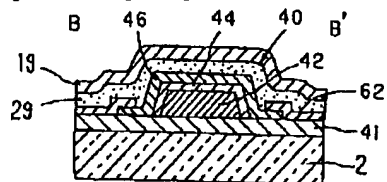
[Drawing 10]



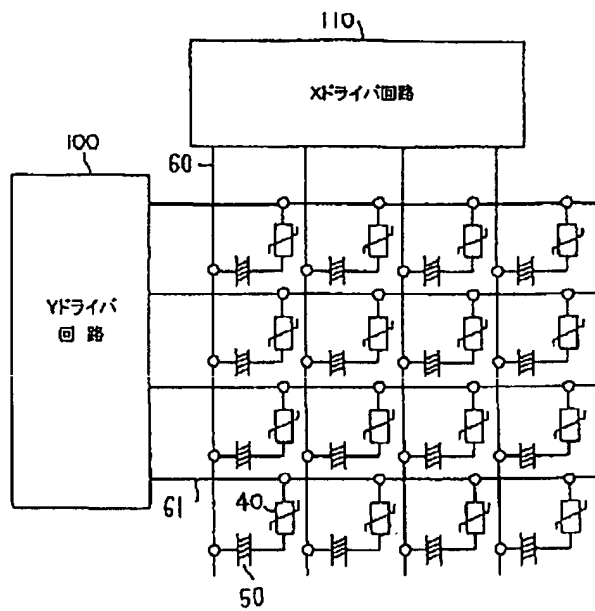
[Drawing 11]



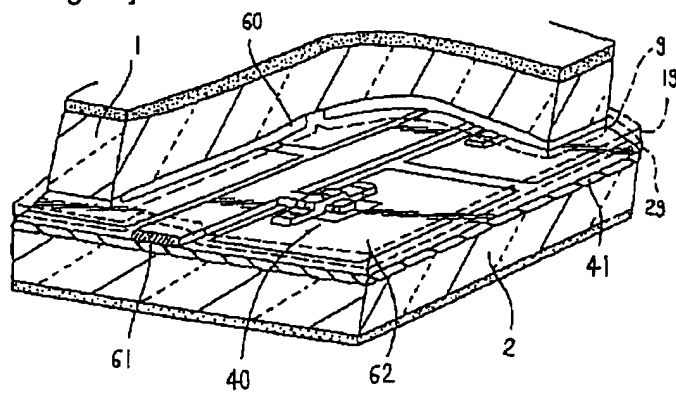
[Drawing 12]



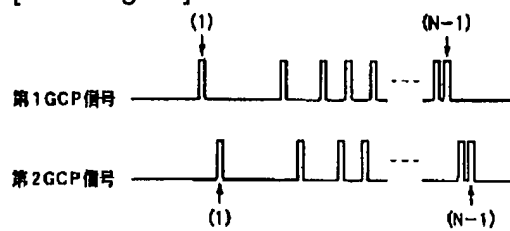
[Drawing 13]



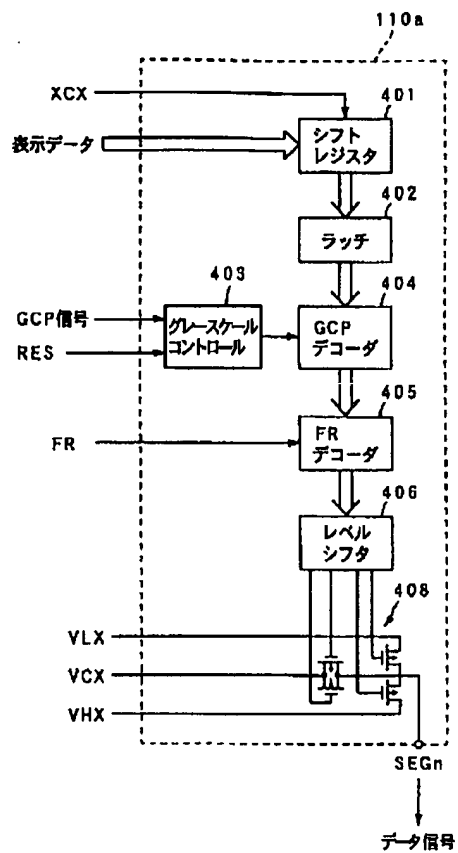
[Drawing 14]



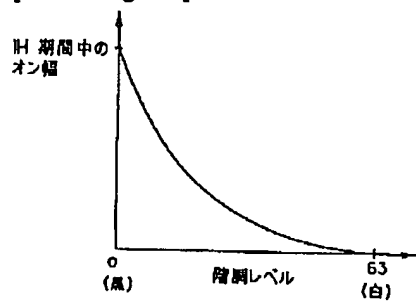
[Drawing 16]



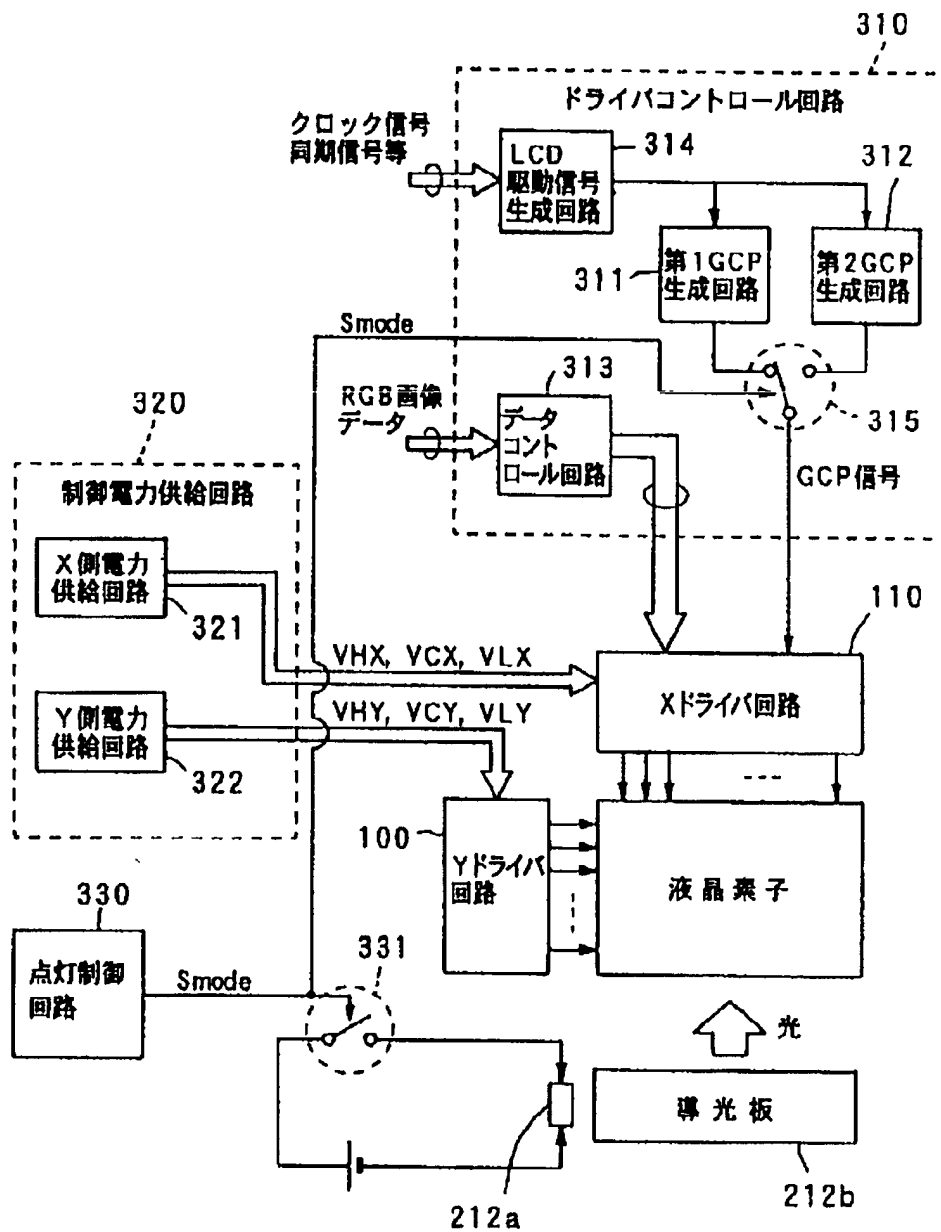
[Drawing 17]



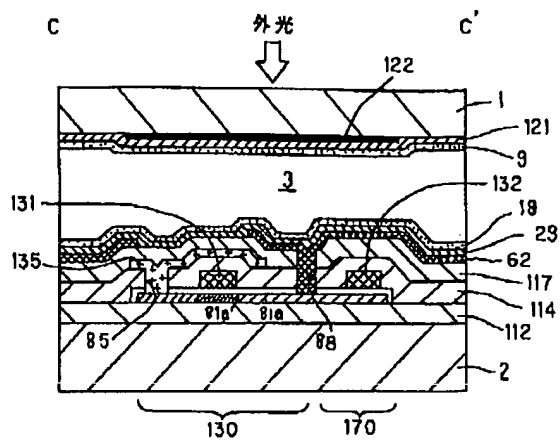
[Drawing 19]



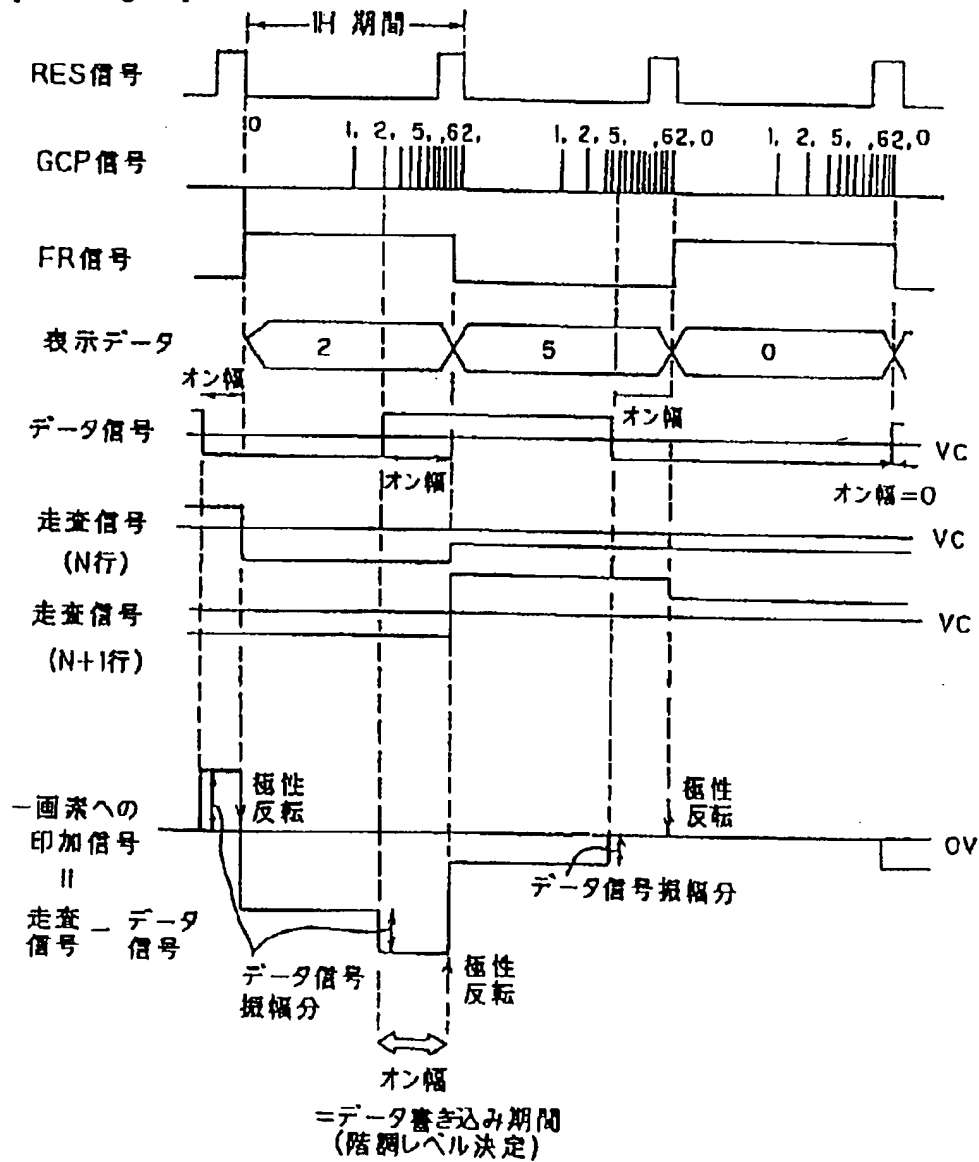
[Drawing 15]



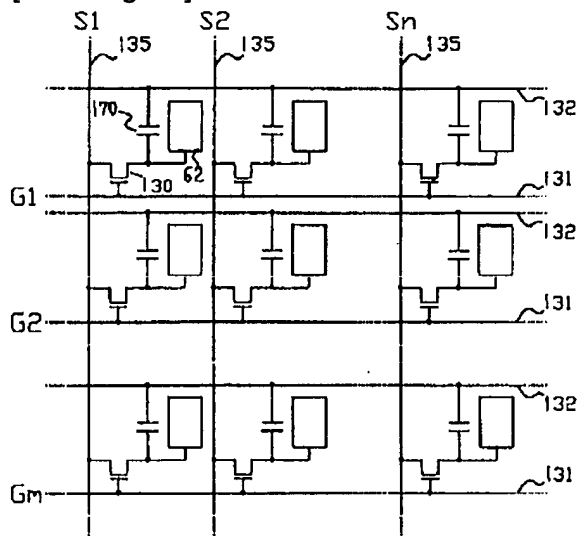
[Drawing 24]



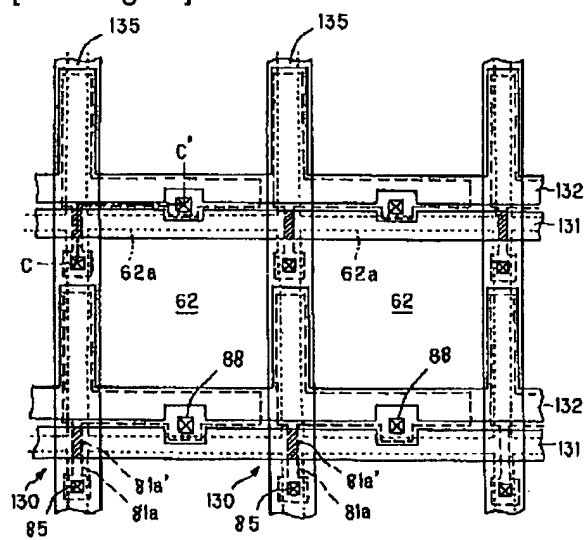
[Drawing 18]



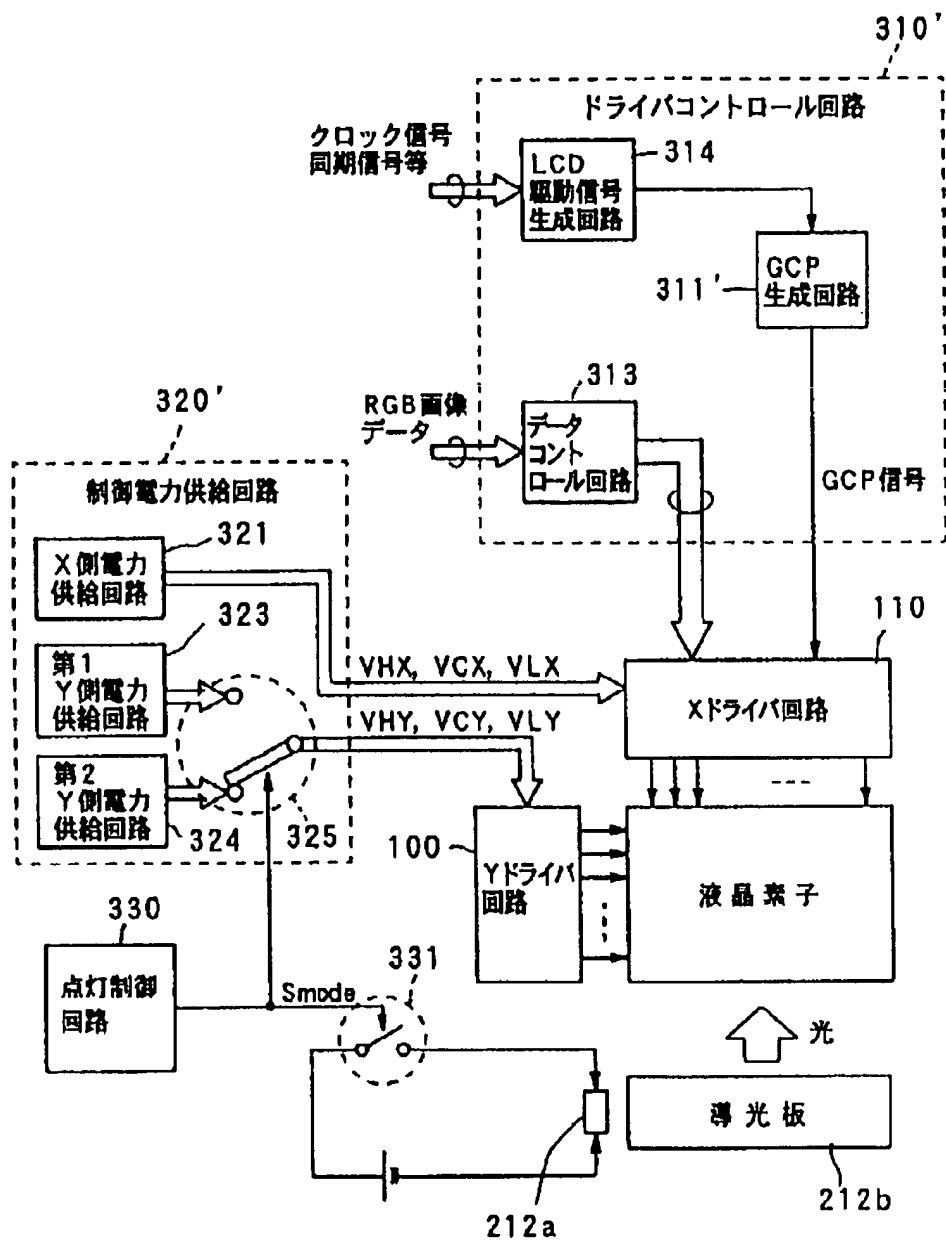
[Drawing 22]



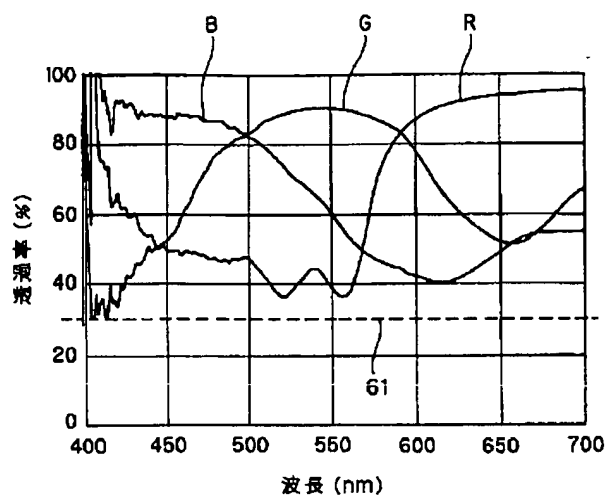
[Drawing 23]



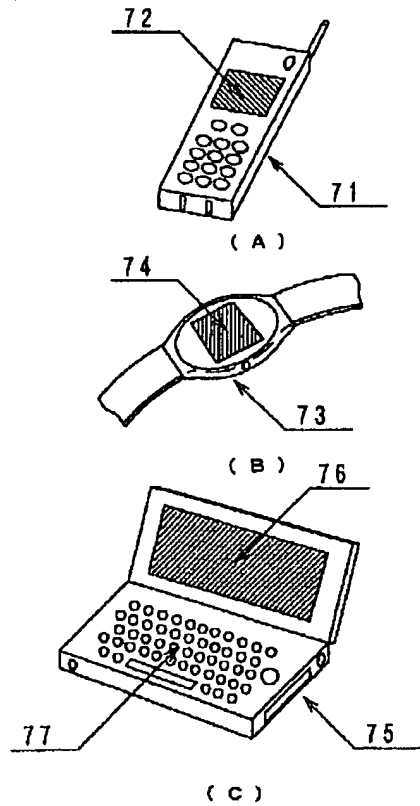
[Drawing 20]



[Drawing 25]



[Drawing 26]



[Translation done.]